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THESIS

THE VP READINESS SYSTEM:
CORRELATING RESOURCES TO PERFORMANCE

by

Michael J. Sakraida
and
James D. Heffernan

June 1990

Thesis Advisor: James M. Fremgen

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The current fiscal environment, with its budgetary uncertainty, forces the Department of Defense to ensure it is receiving the maximum readiness for each dollar spent. This thesis presents an analysis of the current VP readiness system as a method for efficient and effective allocation of resources. It traces the funding for VP squadrons and discusses the training background of individual crews and their specific crew members. It describes the entire military readiness system and how the VP readiness system, as it is used today, relates to this system. The thesis develops a model to illustrate the relationships between resource usage and readiness within the VP community. Several approaches to validate the current VP readiness system were made using this model. However, only limited significant relationships were found. Numerous recommendations to improve the current VP readiness system are made based on the results obtained in testing the model.

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The VP Readiness System: Correlating Resources to Performance

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ABSTRACT

The current fiscal environment, with its budgetary uncertainty, forces the Department of Defense to ensure it is receiving the maximum readiness for each dollar spent. This thesis presents an analysis of the current VP readiness system as a method for efficient and effective allocation of resources. It traces the funding for VP squadrons and discusses the training background of individual crews and their specific crew members. It describes the entire military readiness system and how the VP readiness system, as it is used today, relates to this system. The thesis develops a model to illustrate the relationships between resource usage and readiness within the VP community. Several approaches to validate the current VP readiness system were made using this model. However, only limited significant relationships were found. Numerous recommendations to improve the current VP readiness system are made based on the results obtained in testing the model.

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I. BACKGROUND

Since World War II, Maritime Patrol Aviation (MPA) or VP, as it has come to be known in Navy parlance, has played a critical role in the nation's defense. VP squadrons are among the few military assets which encounter Soviet forces daily through their ocean surveillance and anti-submarine warfare (ASW) missions. These daily confrontations are an important part of our national strategy objective to deter aggression. The MPA mission will undoubtedly be as essential to our future defense posture as it is today.

With the recent events in the Soviet Union as well as Eastern Europe as a backdrop, there is little doubt the military budget will be cut to provide the nation with a "peace dividend." As this paper is being written, a defense budget was submitted to Congress for fiscal year (FY) 1991 with 1.9% growth over FY 1990 (Facts on File, 1990, p.60). This is a 3 to 4% decrease in real funding when inflation effects are taken into account. This trend of funding for the military budget does not appear to be a rare occurrence. Future military budgets are not predicted to increase in real terms for at least several years.

These historically significant events, as well as the requirements of the Balanced Budget and Emergency Deficit Control Act of 1985, more commonly known as the Gramm-Rudman-

Hollings (GRH) Act, will certainly have a major impact on the defense budget. The Act has specific goals of deficit reduction, calling for a balanced budget by 1993. It calls for 50% of the required outlay reductions to be absorbed by the military (Collender, 1987, p. 57). Austere military budgets will undoubtedly continue for years to come.

These defense cuts traditionally come from areas within the Department of Defense (DOD) budget where the money is spent relatively quickly over shorter periods of time. These areas have come to be known as "fast money" expense accounts. Fast money has a faster outlay rate and enables Congress to cut budget authority on an almost dollar-for-dollar basis with outlays, and generally fast money accounts are thought to involve less "pork barrel" politics than other accounts such as procurement and construction (Blake, 1988, p. 47).

The fast money account that is the most vulnerable to GRH cuts is the Operation & Maintenance or O&M account. This account "finances the cost of on-going operations (i.e. base operations, civilian personnel salaries, steam and flying hours, maintenance of real property, training, etc.)." (Practical Comtrollership Manual, 1989, p. A12) Outlays from this account more than any other determine how "ready" a unit is to go to war.

Joshua Epstein, a research associate for the Brookings Institute, provides the following analysis of GRH's effect on the defense budget:

> Beyond this uncontrollable 40 percent of each year's outlays another 30 percent or so is needed simply to pay, house, and administer the defense establishment. Thus if large deficit reductions--that is, cuts in actual spending--are to be made in the current year, and the major capital projects, such as new strategic and naval programs, are protected from reductions; readiness--which has grown with the budget as a whole--is bound to suffer badly. (U.S. Congress, 1987D, p. 78)

The capability of our military has traditionally been measured in terms of four pillars. These four pillars which support the military's mission are force structure, modernization, sustainability and readiness. (Practical Comptrollership Manual, 1989, p. A12) Out of these pillars, readiness more than any other does not lend itself to easy measurement. This is understandable because, by its very nature, readiness is difficult to quantify and not really known until the battle *begins.*

If our military forces are not prepared to fight, they can not provide the required deterrent effect that is a tremendous part of our overall defense. The readiness of our military and in particular our MPA assets to accomplish their missions is of obvious concern to the nation's leadership. Part of this concern is due to the fact that during World War II the allies were not ready to combat the submarine threat. Anti-submarine warfare played a key role in the outcome of the war. By virtue of modern warfare, the United States is not going to have time to gear up for the next major war; it must be ready to fight at a moment's notice. In order to measure a unit's readiness to fight, we must first be comfortable with what is meant by military readiness.

Melvin Laird, Secretary of Defense in the Nixon administration, defines readiness as "the ability of the current configured force structure to perform its assigned mission." (Laird, 1980, p. 2) Readiness is concerned with such things as a battleship's ability to steam to a location and put ordnance on its target when directed or the ability of an MPA squadron to detect, to localize, to track and to destroy enemy submarines when required. It is the ability of military units to do the job appointed to them whenever and wherever the mission is assigned.

The real challenge of the military leadership is to look for ways to create the "peace dividend" without affecting the military's readiness. This means ensuring every dollar is spent with the goal of maintaining readiness. While programs of efficiency and effectiveness are not new, cuts within recent history as significant as previously described are. Unless management systems can be designed to obtain the most "bang for the buck," these cuts will go to the very fiber of the military. Decreased military budgets apparently are the trend of the future; management systems must be designed to ensure readiness is maintained at its peak for the level of funding.

Any system used to measure readiness can do so only through the use of surrogates or substitutes. Many examples can be provided of units rated high in readiness but performing poorly in combat and vice versa (Laird, 1980, p. 17). The problem with any readiness measurement system is that readiness is ephemeral; it changes from minute to minute. Most systems or measures that try to systematically detect and track those changes inevitably fall short in trying to keep up with the sheer volume of them. This thesis will look at the current Maritime Patrol Aviation or VP readiness system to access its performance as a management control tool for the efficient and effective allocation of limited resources.

A. MANAGEMENT CONTROL IN THE MILITARY

A management control system is used to facilitate the effective accomplishment of an organization's mission. The absence of a well designed control system makes the organization vulnerable to inefficiencies which could threaten its very existence (Ramanathan, 1982, p. 2). The success of a management control system is evaluated on the basis of how well the system leads to efficient and effective performance. Simply stated, "effective" means "doing the job you promised to do" and "efficient" means "doing the job with minimum use of resources." (Ramanathan, 1982, p. 4-6) The readiness system is a management control system for the military.

Any management control system must be directed to measure the performance of the organization with respect to some standard. It then must feedback to management to effect change in order to more closely match the standard. Profit is perhaps the largest motivator and measure of effectiveness and efficiency in a business organization. Absent this motive, nonprofit organizations are very limited in coming up with measurement standards. Readiness has become the "profit motive" of military managers. Developing good measures of this amorphous concept has become a big challenge for military managers.

Inasmuch as the military will continue to exist (or operate or function) and will not generate a profit, it must develop good measures of performance. If the military cannot come up with an acceptable quantitative measure of its readiness (in a sense, profit to society) which can be tied to the budget, Congressional reductions of requested funds will undoubtedly occur. Funding then reverts to those with the best quantification of dollars relative to performance (Coleman, 1978, p. 1).

The VP readiness system is used as both a predictor of performance and as a management control system. The patrol aviation community, as well as the whole Navy, has tried to come up with measurements which, when incorporated into the readiness management control system, will be effective in ensuring that commanding officers spend their limited resources in the most beneficial way to the Navy.

This thesis will look at the current VP readiness system and try to determine how well the system can both predict performance and motivate managers to spend money in the most cost effective manner. It will first look at the current system as a predictor of effectiveness. It will then look at proven performance and see if any measurable factors can be identified as being significant contributors to this performance. This, as has been shown, is very critical in times of reduced budgets. If an organization cannot prove its worth by tying expenditures to performance, it does not fare well in the cutback environment which is inevitable for the future.

B. INTRODUCTION TO THE VP READINESS SYSTEM

As has been pointed out, the Department of Defense budget is in for some lean times ahead. Every program will be looked at in order that a fair assessment can be made of its value to our overall defense strategy. The VP program is a major part of this strategy and will undoubtedly be looked at. The more effectively VP is able to translate resource expenditures into readiness the better it can defend its budget as evaluated against other programs' budgets.

The authors see the key to an effective translation of resources to readiness for the VP community as lying within the current VP readiness system. The VP readiness system is the management control system which determines how resources are used within the community. Improving this system serves to improve VP's ability to justify its funding levels within a restricted budget.

A management control system which motivates managers to expend available resources in such a way as to maximize readiness has eluded the VP community, according to a Commander, Patrol Wings Pacific (CPWP) representative. As a former VP squadron Commanding Officer (CO), he stated that, if a critical flight was needed, he would not use the ranking developed from the readiness system to determine which crew was sent. He would instead choose a crew from a personally developed list he felt incorporated all the elements, both tangible and intangible, which gave the crew the best chance for success (Evans, 1990). The personally developed and the readiness system lists may be very different. According to Anthony and Herzlinger, this is not unexpected since, "A judgement made by a qualified person is usually a better measure of the quality of performance than any objective measure." (Anthony and Herzlinger, 1980, p. 237)

The VP community has historically used a readiness figure termed Average Crew Readiness (ACR) as one of the critical measures of effectiveness (MOEs) within its readiness system. ACR is derived from individual Crew Designation Levels (CDLs) which attempt to quantify different elements of individual crew training into one figure. Basically, CDL applies to the individual crew readiness and ACR applies to the squadron as a whole. Chapter VI of this thesis will explain how ACR and CDL are developed and their relationship to the overall Navy and military readiness system.

Traditionally, CDLs are considered to be inflated and at best just an indication of crew performance. However, this measure is used as a tool to provide management with the information necessary to base expenditure decisions. COs feel a motivation to maximize readiness as measured by ACR, or "paper readiness."[1] Herein lies the dilemma which motivated this thesis.

Although CDL is used to signify readiness, it really relates to qualifications, or the process by which paper readiness is gained. It may relate to readiness if qualifications do in fact lead to readiness. There needs to be an established link between paper readiness and actual readiness to ensure resources are expended efficiently. The following model indicates how the authors perceive the current VP management control system:

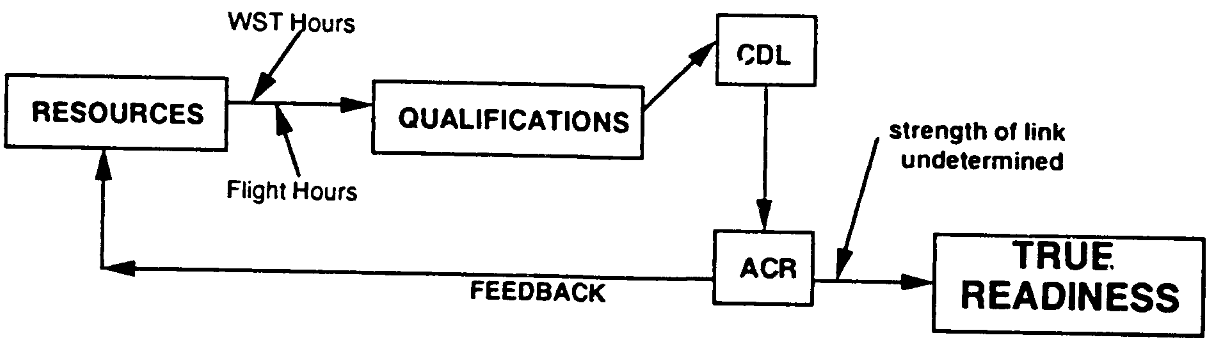

Figure 1. Current VP Management Control System

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[1] Paper readiness is the readiness as measured by CRF and ACR; it may or may not reflect actual readiness.

Resources such as flight hours and Weapon System Trainer (WST)[2] hours are used by the squadron COs to gain qualifications, or "quals." These quals translate directly into CDL and ACR used in the VP readiness system. The readiness system's feedback loop provides information to the CO on how resources can be expended so that ACR can be maximized. The authors contend this feedback bears little relationship to the direction that would be provided if the "true" readiness[3] shortfalls were known or even to the resource expenditure if the CO was left to his own devices to maximize readiness.

Since ACR is perceived as an indicator of the commanding officer's ability to manage resources, he is forced by the system to expend resources on a system that may not really furnishing him with needed information. Commander, Patrol Wing Ten at Moffett Field stated that it was more important for each crew to fly ASW training missions at least once a month than to do qualifications. He stated he did not rank his COs on the basis of their readiness figures, although the COs felt they were rated according to these figures. He was not concerned about the graded performance of the crew as much

[2] A WST is the main ground training device used by VP crews to obtain qualifications and training.

[3] True Readiness is a reflection of how ready a crew is to do a mission, given the ability to incorporate all information into the assessment. Whenever the term readiness is used alone it will be referring to true readiness.

as the fact that they were able to experience actual training. Every training event builds experience that will eventually lead to success. He is willing to let "paper readiness" fall, if necessary, to improve each crew's specific weaknesses (Ryan, 1990). He, in effect, indicated that ACR's relationship to readiness was in question.

The first GRH budget cuts were applied during FY-88 and amounted to a 15% flight hour budget reduction for CPWP forces. Since CPWP distributes flight hour funding to the squadrons, it was required to evaluate the expected adverse consequence of this reduction on readiness. As a member of the staff, one of the researchers was personally involved in that evaluation.

Although numerous attempts were made to arrive at an accurate prediction, the readiness system proved to be of little value in analyzing this problem. The best guess was that some drop in readiness may occur in about four months from the time of the original cuts. Time would prove the guess to be close but only after the fiscal year was over (Mette, 1990). The monthly drop could not be predicted by the readiness system as currently configured. A readiness measurement system should focus on important issues, tie performance measures to resources, and not pay more attention to qualifications than is warranted (Anthony and Herzlinger, 1980, pp. 243-245).

The motivation for this thesis hinges upon the researchers' belief that the current readiness system may be lacking as a management control system. Although any measurement system is better than none at all, MOEs must be constantly reviewed in order for them to maintain applicability to the real world. This thesis will both review the current MOEs for their relevance in today's VP Navy and attempt to identify others that may be more significant.

C. GOALS AND OBJECTIVES

The authors understand that the VP readiness system has remained relatively unchanged for two decades. The reason for this has, perhaps, been more because of the enormity of the research effort required to support the change than the lack of a need for one. As more and more requirements are levied on squadron CO's, something must give. True readiness may suffer because of this. As CO's attempt to maximize "paper readiness," resources are expended that may be used more effectively in other areas if paper readiness does not accurately reflect true readiness.

The goal of this study is to conduct a thorough analytical study of the VP readiness and budgeting systems. The results from this study should help determine if additional factors can be incorporated or excess factors can be removed from the present system, enabling it to become a more viable control system and decision making tool.

The thesis seeks to develop a system that allows individual crews to concentrate on training without being overly concerned with test results. If the system measures the proper factors, the squadron Commanding Officer will have a better system to facilitate management of his resources. The Wing Commanders will be able to better allocate limited resources to squadrons with the greatest need, results will show actual usage, and adjustments can be made to maximize true readiness. When budget cuts are necessary the Wing Commander can more accurately predict the resulting decrease in readiness.

D. SCOPE AND LIMITATIONS

The study initially used readily available aggregate budget and readiness data maintained by CPWP. Failing to obtain satisfactory results, it then developed criteria to identify effective crews and less effective crews from Moffett Field VP squadrons over the past six months. With these crews identified, it explores quantifiable factors involving their training experience from September 1989 to January 1990 which can be used to validate or invalidate the current readiness system.

The factors obtained for the study are limited to records maintained within the squadron training records, flight logs, readiness records and personnel records. These factors include flight hours per month, Weapon System Trainer hours per month, average days between crew evolutions, experience level per crew, flight school grades, etc. Crew analysis was limited to the Patrol Plane Commander, Tactical Coordinator, and Acoustic Sensor Operator 1. While some factors could be substantiated by other sources, the researchers were forced to accept squadron records as being reliable.

E. RESEARCH QUESTIONS

While analyzing the present VP readiness system for its ability both to predict crew operational performance and to motivate VP community managers to employ assets in the most beneficial way, certain questions must be answered:

- What are the distinguishing characteristics of "effective" and "less effective" crews?
- How are these characteristics measured under the present readiness system?
- What training characteristics distinguish "effective" VP crews from "less effective" VP crews?
- Can these training characteristics be expressed in terms of measurable resource expenditures?
- How well does the current readiness system predict the ASW performance of a crew ?
- How does the current system allocate resources to improve performance?
- Does the current system match resource usage to areas where maximum improvement in readiness can be achieved?
- Can changes be made to the current system to improve its ability to perform as a management control system?

F. ORGANIZATION

The thesis is divided into eight chapters. Chapter I gives a background of the issues involved and provides the reader with a sense of the motivation that went into the pursuit of this topic.

Chapter II gives the reader a feel for previous studies on this subject, as well as related works regarding measurement methods. General training criteria are discussed and the applicability to incorporating this into the current readiness system is evaluated.

Chapter III provides insight into current theories on training elements can be applied to the VP readiness system. The elements of training which are pertinent here concern the initial acquisition of skills, the maintenance and refinement of these skills, and finally the evaluation of the effectiveness of the training program.

Chapter IV describes the VP organization. The different crew members within a VP squadron are delineated explaining the various duties of each. The chapter discusses the training program for specific crew members. It then presents the operational chain of command from the President to the VP squadron. This sets the framework for understanding the current readiness system.

Chapter V outlines the fiscal chain of command for the Maritime Patrol Aviation community. It describes the process by which funding reaches the individual VP squadrons and how

CO's are motivated to maintain their funding levels. Finally, a discussion of some of the impacts of funding shortfalls on VP readiness is presented.

Chapter VI spells out the military readiness system in general and how the VP readiness system fits into it. It discusses the system in general terms so that this thesis can be unclassified and be disseminated to the widest possible audience.

Chapter VII discusses the methodology that was developed to examine the current VP readiness system. A description of some of the problems that were encountered in looking at the system is provided. The chapter attempts to validate the methodology chosen through some analytical reasoning. It presents the data that were collected and why those data were chosen over other data. Analyzes are done on the data which point out significant findings. It looks to the results with an eye towards improving upon the current VP readiness system and enabling VP CO's to utilize their resources in areas which provide the most potential for on-station performance success.

Finally, Chapter VIII provides the VP community with some recommendations for improvement of the current readiness system. It provides some conclusions on the entire readiness system and comments on the prospects for making changes in the overall system. The chapter presents conclusions, recommendations, and suggestions for further research so that what was gained in this effort can be expanded upon in the future.

II. LITERATURE REVIEW

In analyzing the current VP readiness system, the authors did an extensive literature review. The examination was done in two stages. First, utilizing sources gleaned from the Naval Postgraduate School's Semi-Automatic Bibliographic Retrieval System, the Defense RDT&E On-Line System, and the Defense Technical Information Center databases, a solid background in military readiness was obtained which was required to base an investigative framework. The second stage of the review was targeted at the learning and training process and how the understanding of this process could play a part in the thesis.

A. READINESS LITERATURE AND VP LITERATURE

Melvin Laird's special analysis entitled *The Problem of Military Readiness* (1980) provided the writers of this thesis with a historical perspective in which to view current military readiness systems. This analysis, together with the book *Management Control in Nonprofit Organizations* by Robert Anthony and Regina Herzlinger (1980), proved very useful in developing measures to validate and improve the current VP readiness system as a means to allocate limited resources prudently.

Thomas A. Musson conducted a study for the Air War College in 1978 which was used by the authors of this thesis in conceptually understanding past readiness measurement systems as management control systems. The Musson study points out that

> The linking of resource allocation and readiness measurement, while obvious on the surface, could cause a whole new series of problems. Any effort to provide the link between readiness and resources must include a careful study of the interrelationship(s) ... that are being addressed. (Musson, 1978, p. 38)

It suggests several areas where tradeoffs play a part in the decision making process to maximize readiness within available resources.

In June 1980, the Training Analysis and Evaluation Group conducted an examination of the operational performance of P-3 pilots as a function of readiness training. This study proved to be an excellent source in developing MOEs to measure crew effectiveness. Several of this study's MOEs, including Naval Air Training and Operations Procedures Standardization (NATOPS) tests scores and months to designation, were incorporated into this thesis. The study served to validate the need to track simulator utilization by crews. It concluded, most importantly, that "no adverse effects on operational performance occurred when the simulator was effectively employed in conjunction with reduced aircraft training." (McDaniel, 1980, p.15) It also added credence to several findings from this thesis with regard to tracking certain crew parameters.

Several recent studies on very focused aspects of the VP readiness and training system were useful in enabling the authors to do directed searches for answers to the specific research questions. The first study by William Blake, entitled *Fiscal Constraints and the P-3 Flight Hour Budget*, (1988) was of tremendous benefit in understanding the effects of budget constraints on P-3 flight hours. It was a natural progression to use this study as a springboard to further tie the budget to readiness. The Blake study was very thorough as a background to this thesis and will be referred to quite frequently.

Another study conducted by the Center for Naval Analyses provides a research memorandum entitled *The Use of Flight Simulators in Measuring and Improving Training Effectiveness* (1986) provides insight into the extent to which military performance is explained by personal characteristics. The analysis develops a model to measure experience level, and education level of a VP aircrew. It then uses these measurements to explain performance levels of reserve and active duty aircrew. The study concludes that reserves perform just as well as active duty aircrew and experience little skill loss over time. This conclusion provides a basis for developing the model used in this thesis. With skill loss being a critical element in any training program, determining this loss so resources can be expended to counteract it is crucial to any readiness system. The study also pointed out aircrew interaction as an area for further research. This thesis attempts to look at aircrew interaction as an explanation for performance variation.

The last recent study dealing with readiness measurement and personnel characteristics was of limited use to this thesis. This thesis dealt with maintenance readiness but pointed out some areas to watch carefully when studying readiness. It points out that any research into a readiness system must take into account the possibility of "gaming" the results. Gaming is the ability to manipulate the measurements so they will produce a more complimentary figure (Maxfield, 1985, p. 32). The authors of this thesis tried to ensure that data was not gamed and biased by those in position to do so.

Finally, the Navy Personnel Research and Development Center did a readiness assessment study in 1986 for the Air Reconnaissance (VQ) squadrons entitled *Development of a Computer-Managed Readiness Assessment System*. It discusses the development of an instantaneous readiness assessment system for the VQ community. Many of the conclusions are universal in nature and could easily be transferred to the VP community. The research provides support to several of this thesis' conclusions and recommendations.

B. TRAINING SPECIFIC LITERATURE

The peace time military is constantly training. The readiness system should measure this training and provide feedback to management as to where additional resources are required. Before it is possible to evaluate a management control system, which is based in large degree on skill retention, it is essential to understand the nature of training and how to achieve the highest level of performance from each member or crew. Therefore, the second part of the review of academic literature concentrated on issues concerning learning (training), motivation, and evaluation. This section provides a synopsis of literature used in writing this thesis. Chapter III expands on the learning theories gathered from these sources and applies them to training in the VP community.

The first text reviewed was the *Taxonomy of Educational Objectives*, edited by Benjamin Bloom (1956). It lays the ground work for understanding the learning process. Especially important to this thesis are Bloom's views concerning evaluation and will be a basis for some of this thesis' recommendations.

Henry Ellis' *The Transfer of Learning* (1965) provides insight into how learning can be transferred from one task to another. He discusses the amount of practice required to learn a skill, expressing the need for a great deal of practice in the beginning stage of skill development and less frequent after the skill is learned. This information should be taken into account when developing any training system.

As the title implies, *Theories of Learning* by Hilgard and Bower (1975) presents several current studies and theories that apply to learning. Two of these studies are extremely appropriate to this thesis. The first concerns the timing of practice to maximize skill retention. The second deals with motivation as it relates to performance. It concludes, essentially, that motives are the psychological factors which convert knowledge into action.

Learning and Motivation by Frank Logan (1970) is an introduction to motivation as it applies to learning situations. This work differentiates between learning and performance. It is Logan's theory that learning takes place without external incentives being present. However, motivation is required to get the best performance from this learning. In addition, Logan discusses at what pace practice should be conducted. Both concepts are appropriate and utilized by this thesis.

Educational Psychology by Louis Smith and Bryce Hudgins (1964) draws upon some of the most important research and theory available in the area of educational psychology including the work of B.F. Skinner, George Homans, and David McClelland. Smith and Hudgins present basic concepts of educational psychology, such as measurement, behavior, personality, theory of learning, and the development of intellectual skills and abilities. This thesis will touch on their studies dealing with optimum timing between practice events.

The final review is of the national bestseller *In Search of Excellence* by Thomas J. Peters and Robert H. Waterman (1982). This well documented book puts theory into practice and gives insight into what management techniques work best. The researchers profited from chapters dealing with positive reinforcement and intrinsic motivation. Both are essential elements in a viable management control system.

The literature searches were unable to locate specific studies or research done on the entire VP readiness system. The searches, together with our interviews with current leadership within the VP community, underscored the need for such a comprehensive look at the system. While studies have been done on particular aspects of the system, no recent studies have looked at the composite system. This thesis, in attempting to look at the entire VP readiness system, while keeping it relevant to individual squadron commanding officers within the system, has done something never attempted before in the VP community.

III. TRAINING ELEMENTS

An essential ingredient of readiness is training. Elements of training which are pertinent here are the initial acquisition of cognitive and development of psycho-motor skills. Following this are the maintenance and refinement of these skills. The readiness system is designed to evaluate the quality of the performance of each aircrew and, thus, reflects upon the effectiveness of the training program. A grading system provides the trainees with an evaluation of their performance and outlines for them what is necessary to achieve the required level of performance. The following sections provide insight as to how theories on training and evaluation can be applied to the VP readiness system.

A. TRAINING

According to Bloom there are six stages of learning which can be easily applied to any training situation. These are knowledge, comprehension, application, analysis, synthesis, and evaluation. Each stage is thought to build upon the previous stage. Bloom defines knowledge as "behaviors and test situations which emphasize the remembering, either by recognition or recall, of ideas, material, or phenomena." (Bloom, 1956, p. 18) In comprehension the emphasis is on understanding the meaning and intent of the material. The emphasis in application concerns remembering and bringing to bear upon given material the appropriate generalizations or principles. Analysis emphasizes the breakdown of the material into its component parts and recognizing the relationship and organization of the parts. Synthesis generally involves a combining previous experience with new material creating a new integrated whole. Finally, Bloom defines evaluation as an individuals emphasis on appraisal of internal or external evidence concerning himself. (Bloom, 1956, p. 18) The emphasis of this thesis, however, concerns evaluation of an individuals performance by others.

The first two stages are completed while VP students are in preliminary training, prior to coming to a squadron and becoming members of a particular crew, and are beyond the scope of this study. Of the remaining four, this thesis will concentrate on application and evaluation.

At the squadron level "the training really begins." The new crew member is integrated with more experienced members who already have acquired "readiness." Learning from experienced crew members is appropriate and efficient. However, the new member needs immediate reinforcement (application) of his new-found knowledge. "The decay theory of forgetting simply states that memory, like all biological processes, deteriorates as time passes." (Hoffman, Vernoy, and Williams, 1987, p. 261) If the other crew members are highly experienced and fully qualified, the new member is likely to get less practice because the readiness system may say the crew is qualified and no further training is required at this time. The new member's skills are highly perishable and valuable learning may be lost or delayed. Ellis provides us with an important insight into this aspect of learning or transference of knowledge.

> ...extensive practice on the original task increases the likelihood of positive transfer to a subsequent task, whereas more limited practice may yield no transfer or even negative transfer. Harlow implies that very thorough practice should be given in the early stage of developing new skills and concepts. Later on, such thoroughness may not be required. (Ellis, 1965, p.71)

Anti-submarine warfare (ASW) is considered a perishable skill (Smith, 1990). That is, all crew members require skill reinforcement if improvement or skill maintenance is to be expected (Hilgard and Bower, 1975, p.201). Additionally,

> ...in one skill-retention study for Device 14A2 Surface ASW Attack Trainer, skills were evaluated in the training device at periods from 8 to 16 weeks after initial device training was completed. The results showed that the students rapidly forgot what they learned, indicating the need for frequent refresher training. (Micheli, 1972, p. 140)

There is a tendency in the readiness system to group training. This means a crew trains to achieve a set of ASW standards (or qualifications) in a short period of time. Then there is a long period of limited ASW training, while the next crew is achieving its qualifications. This occurs repeatedly until the set of qualifications have expired. The sequence is then repeated. However, a number of studies have indicated that training time is better spent when the periods are broken up and distributed over time.

> Whether you learn verbal materials...or motor skills such as typing, you are better off spacing your learning periods, with rest periods between practice sessions. Psychologists call this learning strategy distributed practice. (Hoffman, Vernoy, and Williams, 1987, p. 246)

Davidoff reports that "distributed practice is particularly effective for learning motor skills..." (Davidoff, 1987, p. 209) The Ellis and Davidoff studies do not set guidelines for intervals between events but, rather, suggest a general principle. Schedule practice periods between the extremes of too often (overcrowding) and too seldom (forgetting). Harmon and Miller (1957) found an optimal arrangement which they called "additive time patterns." Essentially, they suggested to crowd practice initially, in our case, for junior crews or junior crew members, and then provide a greater distribution of practice when the basics have been fully achieved and each additional step can build upon the next. (Smith and Hudgins, 1964, pp. 457-458)

The way one trains is also important. As previously thought, practice does not make perfect, but rather depends upon what is practiced. For example, extensive practice at a slow pace may interfere with later learning to respond quickly. (Logan, 1972, p. 199) This is especially important in ASW, which often requires a rapid response.

B. MOTIVATION

A properly developed readiness system should provide incentives to improve performance. Motivation relates to performance. Motives or drives are considered to be those psychological factors which are responsible for converting knowledge into action. (Hilgard and Bower, p. 21)

Logan's studies have shown that learning actually takes place at about the same rate whether or not rewards are present (Logan, 1972, p. 199). The difference is that the results of the group without the rewards may be latent and not demonstrated until some reward is available. This is true as long as the motivational level is normal. If this level falls, then reduced motivation will affect learning and, in turn, influence the transfer of learning. If a student is poorly motivated, he will tend to learn less and thus reduce the chance of transfer to new learning situations.

The VP community and the military in general are made up of members that are intrinsically motivated. They would not be there unless they wanted to be. They consider themselves professionals and are committed to do well. Due to standards for admission, all are capable of a high level of performance. Therefore, the system should take advantage of this motivation and recognize that its members will learn if given adequate training.

C. EVALUATION

Evaluation is an important part of learning and performance. Evaluation should provide appropriate feedback so that what is learned is what should be learned. Evaluation establishes how well one achieves learning objectives. Objectives not only provide the learner with what he must do but also provides the basis upon which the evaluation is made. The achievement of objectives provides motivation for improving performance.

Evaluation can also be a source of anxiety for many crew members. According to Spence (1964), anxiety is viewed as a motivational variable that increases the probability of various responses being made in a learning situation that involves relatively simple types of learning. However, anxiety tends to interfere with performance in more complex learning tasks. (Ellis, 1965, p. 65) ASW is viewed as a complex learning task, since crew members are expected to perform several functions at the same time; they must maintain constant accurate communication with crew members, manipulate complicated electronic equipment, and interpret data which enable them to make appropriate decisions. Crew members afraid of failure will suffer a reduction in learning. (Logan, 1979, p. 34)

The VP community may evaluate its crews excessively. This is probably not unexpected for, as Bloom states,

> Man is apparently so constituted that he cannot refrain from evaluating, judging, appraising, or valuing almost everything which comes within his purview....It is quite possible that the evaluative process will in some cases be the groundwork for the acquisition of new knowledge, a new attempt at comprehension or application, or a new analysis and synthesis. (Bloom, 1956, p. 185)

However, because of the simplicity of testing specific knowledge, evaluation is frequently emphasized out of proportion to its usefulness or its relevance to the situation. A problem occurs when excessive evaluation ceases to be a positive motivating factor and causes a decrease in learning. The motivation then changes to just meeting grading criteria and away from learning (Bloom, 1956, p. 34).

The concepts discussed in this chapter are used as a basis for evaluating the current VP training and readiness system. Findings from statistical tests presented in Chapter VII of this thesis add credence to the theories discussed in this section.

IV. VP ORGANIZATION

To grasp the meaning of terms presented in later chapters and to gain an appreciation for the resources expended by the VP community in order to maintain readiness, one should have an understanding of its purpose and organization. The overall responsibility of the VP community is to keep the sea lanes open. From this responsibility two major VP missions have emerged; anti-submarine warfare (ASW) and surveillance. The ASW mission has traditionally been given the highest priority.

The typical ASW mission involves a one hour aircrew intelligence and mission brief followed by a three hour preflight check of aircraft systems. A crew normally flies one to four hours to the mission area (on-station) before beginning its assigned task. This ASW mission involves the dropping of sonobuoys in the water at different depths to acoustically acquire and track submarines. The mission usually culminates with a simulated weapon drop on the submarine. Once the mission is completed the crew returns home, postflights the aircraft, and debriefs the mission at the Wing and obtains a graded evaluation or on-station effectiveness (OSE).

Recent events have emphasized the VP surveillance mission with its drug interdiction capacity. However, since ASW is the dominant VP mission, the skills involve in the mission are perishable, and the readiness system stresses ASW, this thesis views the readiness system from an ASW perspective.

This chapter describes the various crew members who comprise a VP aircrew and the role each individual plays in the VP ASW mission. It then describes the training invested in three particular crew members on whom this thesis concentrates much of its attention. Finally, the chapter reveals how the entire organization fits into the overall defense structure.

A. VP CREW MEMBERS

A crew of twelve officers and enlisted men typically fly an ASW mission in the Lockheed P-3C Orion aircraft. This standard crew consists of five officers (three pilots, a tactical coordinator (TACCO), and a navigator/communicator (NAV/COMM)) and seven enlisted men (two flight engineers (FEs), two acoustic operators (sensor station 1 and 2 (SS1 & SS2)), a non-acoustic operator (sensor station 3 (SS3)), an ordnanceman, and an in-flight technician (IFT). Each crew member performs a unique task for the overall VP mission. The following section gives a brief description of each position on the "standard" P-3C aircrew. Seniority and experience levels of actual crews may differ from those described; however, those differences are the exception and not the rule.

The senior most qualified member of the crew is designated as the mission commander. The mission commander (usually the senior of the crew TACCO or Patrol Plane Commander (PPC) is responsible for the overall mission success. His decisions are final when any differences arise regarding tactical employment of the aircraft.

Although only two pilots can actually have physical control of the aircraft at any one time, three pilots are attached to the standard aircrew. This assignment is for safety reasons; flying with an additional pilot enables the aircraft to be flown to its maximum endurance limits. The PPC is the most experienced pilot on the crew and as such is responsible for the physical aircraft. He is in charge of the safe operation of the aircraft during the entire assigned mission. The second pilot (2P) and third pilot (3P) are junior to the PPC and have less experience, knowledge and qualifications than the PPC. The 3P and 2P are at various stages in the pilot training syllabus and are working towards the ultimate goal of being designated a PPC.

Two FEs fly with the standard crew, even though only one can physically perform his duty at a time, for the same safety reasons as with the pilots. The FE is the primary assistant to the pilots in ensuring flight safety. By performing maintenance on various flight systems when not flying, the FE is an expert on these systems of the P-3. He sits between the two pilots and assists them as necessary in monitoring and manipulating various components of the aircraft's controls. Normally one flight engineer is fully qualified to perform his duties and the other is in the FE training syllabus.

The senior of the two Naval Flight Officers (NFOs) on the crew is the TACCO. The TACCO is responsible for implementing appropriate strategy and procedures and utilizing sonobuoy and weapon loads as the tactical situation dictates. He runs the tactical problem from his station and directs the activities of all other crew members to ensure effective employment of the crew and aircraft, given mission constraints.

The NAV/COMM is the junior NFO on the crew and is responsible to navigate the aircraft to and from an operational area, to transmit reports in accordance with directives and to assist the TACCO as necessary. He is responsible for maintaining an accurate log of geographical positions and important events so that the mission can be reconstructed during post flight analysis. His objective in the squadron training syllabus is to be designated a TACCO.

The two acoustic system operators, SS1 and SS2, are responsible to detect and to classify acoustic contact data that is presented to them on their sensitive listening gear. They are to become familiar with the ASW environment which presents itself on a particular mission so that the TACCO can employ effective tactics. The SS1 and SS2 stations on the aircraft are basically similar. The SS1 is fully qualified to perform his responsibilities, while the SS2 is in the process of training to be a designated SS1. For the most part, experience in the aircraft is all that distinguishes a SS1 from a SS2. No new systems must be learned in the transition from SS1 to SS2, as is necessary in the transition from NAV/COMM to TACCO.

The only non-acoustic operator on the aircraft, the SS3, is responsible for all the aircraft tactical systems which do not directly involve acoustic information. His duties involve the use of the radar, electronic support measures (ESM) and magnetic anomaly detection (MAD) gear. He utilizes the systems available to him as the TACCO directs.

The ordnanceman is responsible for loading search stores, such as sonobuoys, and kill stores, such as torpedoes, as directed by the TACCO. He must coordinate all the logistics required for those loads. Depending on squadron policy, he normally acts as photographer for the crew when mission objectives require.

The IFT normally repairs all the aircraft avionics when not flying and is experienced in troubleshooting techniques. He aids in preflight checks of all major aircraft systems and is responsible for ensuring that the checks are acceptable prior to takeoff. Once in-flight, he uses his system knowledge to ensure all aircraft avionics perform without flaw when required.

B. CRITICAL CREW MEMBER TRAINING

Since ASW was determined to have the greatest requirement for resource usage in the VP community, the authors concentrated the analysis on those crew members who have the most responsibility in performing this mission. The crew members which were selected were the TACCO, PPC, and SS1. These three crew members were determined to have the greatest impact on overall crew performance in the ASW mission. All other crew members support these three on this mission.

While the VP readiness system recognizes the SS3 as a "critical" crew member, the authors' analysis of Fiscal Year 89 flight data indicated that the SS3 did not play a significant role in performing the assigned mission in more than 4 percent of the operational flights. For this reason he was deleted from further analysis. The thesis analyzed the characteristics of the three critical crew members for specific measurable factors which might explain crew performance disparities. The following section provides a comprehensive background of the training of these crew members.

The PPC is a commissioned officer who has physically met the Navy requirements to become a pilot. Following commissioning he travels to Pensacola, Florida and attends a six week aviation indoctrination (AI) course. This course involves physical testing and water skills testing, as well as basic aeronautics and basic engineering ground school. After completing AI, the pilot attends basic flight school for 20 weeks. Here he develops his flying skills in the T-34C aircraft. The grades he earns in this course play a significant role in determining his eligibility to fly jets, propeller aircraft or helicopters. If he is selected for propeller training he is assigned to the advanced propeller training course in Corpus Christi, Texas. Completing this course earns him the coveted Navy "wings of gold." Upon pinning on his wings, he is sent to a Fleet Replacement Squadron (FRS) for approximately 22 weeks of training in the P-3 model he will subsequently fly. VP-31 in Moffett Field, California and VP-30 in Jacksonville, Florida are the P-3 FRSs for the west and east coast VP squadrons, respectively.

Completion of the FRS training syllabus certifies the pilot is ready to join the fleet. The pilot is assigned to his first squadron in any of four locations, Moffett Field, California; Barbers Point, Hawaii; Brunswick, Maine; or Jacksonville, Florida. Once assigned to the squadron, he is expected to qualify within twelve months of squadron check-in as a 3P, within 18 months as a 2P and within 24 months as a PPC. Mission commander designation is usually acquired after six months of being assigned as a crew's PPC.

The TACCO is a commissioned officer who has physically met the Navy requirement to become a pilot, with the exception of visual acuity. An NFO's eyes are not limited to uncorrected 20/20 vision, as for a pilot; his vision may be correctable to

20/20 with glasses. After commissioning, he attends the same AI course with the pilots. From this course he is assigned to Training Squadron 10 (VT-10), where he spends approximately 16 weeks learning basic flying skills. The course culminates in five flights navigating and performing all the communications for the T-2C aircraft and plays a major role in his eligibility for the different NFO career paths (fighter, attack, patrol etc.) If he is chosen for the patrol community career path, he attends a 20 week multi-service navigation school to gain skills in long distance navigation in the Air Force T-43A aircraft. After graduation from navigation school he earns his "wings of gold" and is sent for approximately 22 weeks to one of the two FRSs with the pilots. Here he begins to learn tactics and P-3C aircraft systems which will be used on the various missions he will be required to fly. After completion of the FRS, he obtains orders to one of the previously described VP locations. The NFO goes through each squadron's training syllabus and qualifies as a NAV/COMM in about 12 months and as a TACCO in another 12 months. He typically is designated as mission commander six months after being assigned the TACCO for a crew.

Enlisted men in the anti-submarine warfare (AW) rating fill the SS1 and SS2 positions on a VP crew. To be qualified for this rating the enlisted recruit must meet some relatively stringent requirements, including an armed services aptitude battery test (ASVAB) multiple of 200. This ASVAB multiple is very high relative to other ratings (Gonzalez, 1986, p32). After graduating from the seven week initial training course all Navy recruits attend, the recruit is sent to Aircrew Candidate School (ACS) for five weeks in Pensacola, Florida. Here the recruit learns about general aviation, safety procedures and swimming. Upon completion of ACS the aircrewman is sent to AW "A" School for eleven weeks of classroom instruction in sonar principles, sound physics, and acoustic analysis. From "A" school the newly designated AW is assigned to Fleet Aviation Specialized Operational Training Group (FASO) collocated with the FRSs in Moffett Field and Jacksonville. FASO introduces the AW to the equipment he will be using on the P-3C aircraft. He begins to apply principles he has mastered to real world scenarios. Upon completion of FASO training the AW is assigned to the FRS and begins to fly on the P-3C aircraft with the other crewmen. Here all his previous training comes together. FRS completion enables the AW to be assigned to his squadron. The AW normally qualifies as a SS2 in twelve months and as a SS1 in an additional twelve months.

C. VP OPERATIONAL CHAIN OF COMMAND

Currently, squadrons are manned to support 12 aircrews and nine P-3 aircraft. As this thesis is written, however, the squadrons are being reduced as a result of budget cuts. There are currently 24 active duty VP squadrons in the Navy, with approximately 300 officers and enlisted men attached to each. Twelve of the squadrons are on the east cost, seven in California, and five in Hawaii.

Two different chains of command dictate how and what missions will be performed by VP squadrons. The operational chain of command for Moffett Field squadrons is shown in Figure 2. The administrative chain of command is described in the next chapter. As can be seen in the figure, the chain of command is straight forward. Of note is the fact that Moffett Field squadrons which are not deployed report directly to the Wing Commander. When a squadron is deployed to the seventh fleet's area of responsibility (including much of the western Pacific), the Wing Commander is out of the operational chain of command.

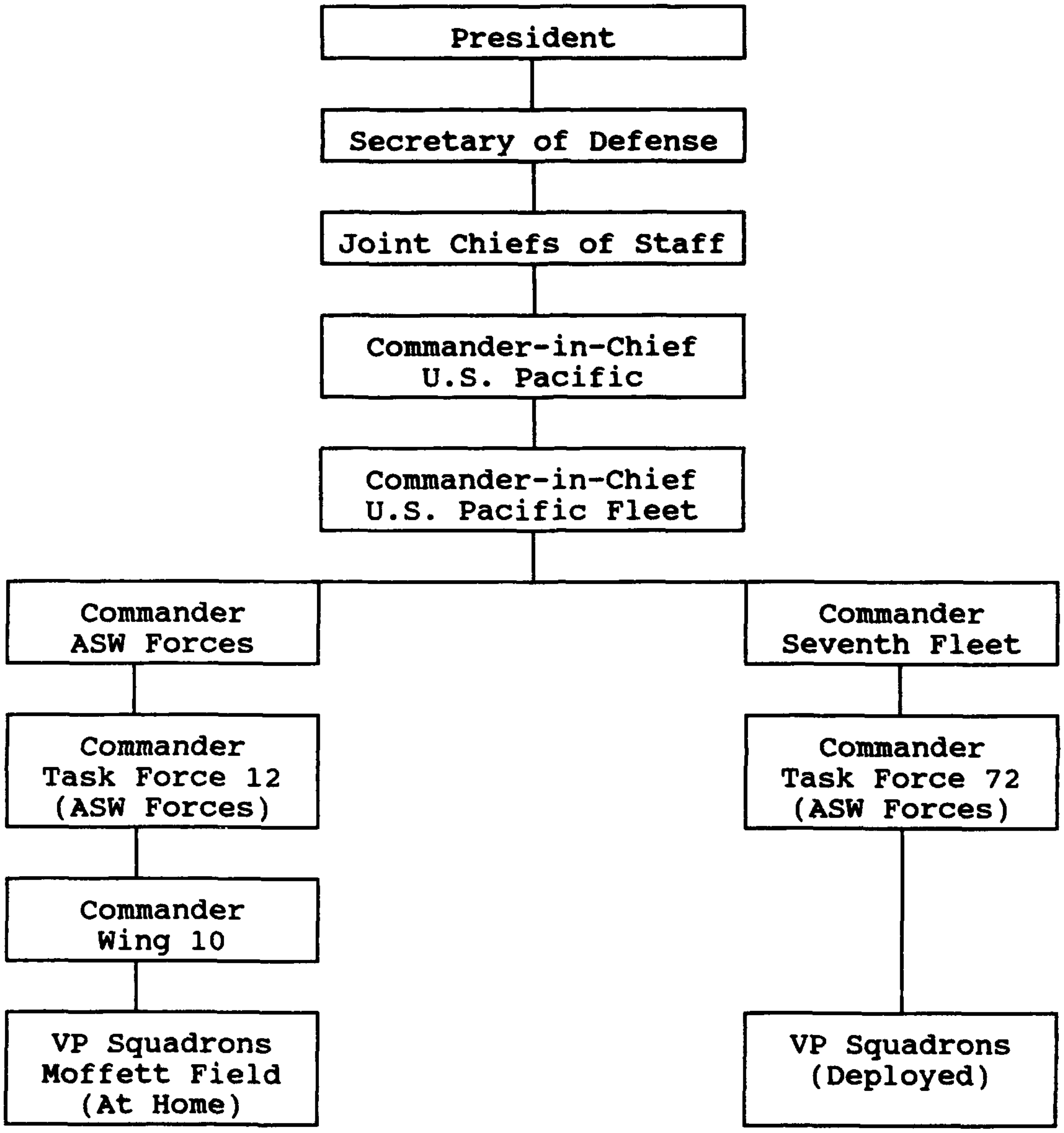


Figure 2. VP Operational Chain of Command

V. THE BUDGETARY PROCESS FOR VP SQUADRONS

This chapter is devoted to explaining the VP fiscal requirements and administrative chain of command for the Maritime Patrol Aviation community. It details the process by which VP funding is obtained and, in particular, how flight and Weapon System Trainer hour funding budgets are developed. It describes how the funds are distributed down the chain of command and finally what happens when the funds reach the individual VP squadrons.

Squadron commanding officers receive in excess of $2 million a year to operate their squadrons. This involves everything from flying their aircraft to buying pencils. Before the Congress appropriates funds, those who use the funds must provide budget figures. This process, called budget formulation, is practiced at all levels in DOD. Approximately 95% of operational aviation squadron funding involves flight hours and revolves around a concept called Primary Mission Readiness or PMR. The following section describes this concept and its use in DOD budget formulation.

A. PRIMARY MISSION READINESS (PMR)

The basis for programming of flight hours for VP as well as other aviation communities has, for several years, been defined by Primary Mission Readiness. PMR is derived from a compilation of the average number of flight hours required for each crew per month to insure adequate performance in each assigned Primary Mission area. A Primary Mission is an area of specialization in which an operational unit (VP squadron) is required to maintain combat readiness. The Chief of Naval Operations (CNO) assigns Primary Mission areas to all naval units. ASW is the most important Primary Mission area assigned to the VP community (CPWP Flying Hour Program, 1984, pp. II-1 and II-2) and the area that requires the greatest concentration of training effort to remain combat ready. Training programs and standards have been established to ensure the fulfillment of these requirements.

The first step in understanding PMR is understanding how VP functions. Essentially, VP squadrons are in one of three phases at all times -- deployed, ready/alert (R/A), or training. These phases make up an 18-month cycle, with six months deployed and twelve months at home divided between training and R/A phases.

Deployment, as mentioned earlier, refers to the squadron actually leaving its home base for an extended period of approximately six months. When required, the deployed squadron is directed to conduct any of its assigned Primary Missions in an operational environment. The ready/alert phase is similar to deployment in that a squadron will be assigned operational flights but remains at its home base to perform these missions. This phase lasts one month at a time and normally occurs three times during the typical twelve month at-home period. Training is conducted in each phase when operational flights are not required. Any time the squadron is at home and not in the R/A phase it is in the training phase.

In 1976, Commander Patrol Wings Pacific (CPWP) sponsored a PMR study which quantified the flight hour requirements for each phase. It specified the amount of training that can be derived from every hour of an operational flight as well as a dedicated training flight. The training hours it prescribes are supported by an extremely detailed breakdown of squadron training needs. From this study an overall PMR value for VP crews was established. The phase a squadron is in determines what percentage of the PMR value that its crews will be budgeted for. This study was later revised in 1984 to include the flight hour reduction benefits derived from simulator usage. The study, entitled CPWP Flying Hour Program, remains the cornerstone of VP flight hour budget formulation (CPWP Flying Hour Program, 1984).

Flight and aircrew simulators provide a highly cost-effective substitution for inflight training. As aircraft operating and maintenance costs continue to increase, maximum utilization of simulators assumes critical importance. Therefore, it is necessary to examine this important training resource and its effect on PMR, which in turn influences budget formulation.

B. SIMULATORS

Basically, CPWP controls two types of simulators, a flight simulator for pilot training and a Weapon Systems Trainer for aircrew ASW training. Although the trainers are expensive to purchase (currently $30-40 millon per unit, about the price of one P-3 aircraft), they are extremely cheap to operate and maintain. At an average cost of $29 per hour to operate a trainer, they are definitely a bargain when compared to the $1250 per hour cost of flying a P-3 (Jerry, 1990).

At first glance, trading simulator time for flying hours appears to be an answer to reduced budgets. But, on close inspection, one finds that simulator shortcomings cloud this picture. A major problem of simulator substitution is that, as exposure to the device increases, pilots will improve at a decreasing rate. This implies the pilot initially gains meaningful training at a very rapid rate. As the training device is pushed to its limits of simulation, transfer of real-world flight experience slows until the aircraft must be used to gain the needed realism. While the simulator does offer trade-offs in piloting skills, it does not provide a one-to-one substitution for aircraft flight hours (CPWP Flying Hour Program, 1984). This finding is in concert with Ellis (1965) and his studies on the transference of learning.

In addition to operational flight simulators, the Weapon System Trainer supports P-3 aircrew training requirements. This simulator reproduces the P-3 aircraft aft of the cockpit.

The ability to "freeze" the trainer when crew coordination problems are detected make this device an invaluable complement to actual ASW training flights. Aircrew tactical simulator utilization consists of qualification exercises, crew coordination, aircrew positional upgrade training (e.g., to advance from SS2 to SS1), predeployment training, and pre-exercise training.

Although the WST is an excellent training device, there simply are not enough properly configured tactical trainers available to fully support fleet demand. For example, a single WST (P-3 UIII model) supports the Fleet Replacement Squadron (FRS), five squadrons , and a reserve squadron. Therefore, squadrons can not take full advantage and often require additional flight hours to meet ASW training requirements (CPWP Flying Hour Program, 1984). With today's tight budgets, these additional flight hours may not always be available.

With all the above factors taken into account, the CPWP study found that the two types of simulators reduce monthly PMR requirements. The flight simulator time is substituted for three hours of PMR and the WST simulator is substituted for an additional six hours. Thus, overall flight hour requirements are reduced by nine hours per crew per month.

C. BUDGET DERIVATION FROM PMR

The following are the basic formulas for determining annual flight hours and the budget required to fund these hours:

Annual Flight Hours = PMR X (11 crews/squadron)
X (12 squadrons) X (12 months)

Annual Funding = Annual Flight Hours X Cost per Flight Hour

The cost per hour is determined by the DOD contracted fuel price for the year multiplied by the historical average of gallons per flight hour used by each model of the P-3 aircraft (Blake, 1988, p. 14). Historical maintenance and average specific equipment repair costs are then added to this figure to give the total cost per flight hour. The annual funding is then derived from the annual flight hour requirement multiplied by the total cost per flight hour.

Given on the annual funding figure for all VP squadrons, Commander, Naval Air Pacific (CNAP), the Operating Budget Holder, combines this figure with all other aviation units under its command and submits this as part of its budget up the chain of command.

D. APPROPRIATION AND ALLOCATION

The Appropriation Act is enacted by Congress and signed by the President. The Treasury department then issues Appropriation Warrants to the General Accounting Office (GAO) for countersignature to guarantee agreement between the executive and legislative branches prior to execution. Warrants specify the amount for a particular appropriation and any restrictions placed on the account by Congress. The countersigned warrants make the appropriated funds available for apportionment by the Office of Management and Budget (OMB).

Funds are apportioned by OMB to the Department of Defense, which in turn apportions funds to the Department of the Navy. These funds are generally apportioned without subdivisions for programs or projects. O&M,N funds are annual appropriations but are apportioned on a quarterly basis.

OMB apportions funds only at certain scheduled times during the year in order to

- control the obligation and expenditure of funds over a period of time;
- achieve the most effective and economical use of funds;
- guard as much as possible against deficiency or supplemental appropriations;
- release only those funds required to meet the latest plans; and
- prevent obligations and expenditures in excess of available amounts. (Practical Comptrollership, 1989, p. D-4)

Although these are strong justifications for quarterly apportionment of funds, this procedure has serious shortcomings for Navy management. Commands which ultimately receive these funds are forced to accept short term planning as a way of life.

The apportioned funds go next to the Chief of Naval Operations (CNO) and the internal distribution of funds or allocation process begins. Whereas the purpose of apportionment is to control the rate at which funds are obligated, the allocation process controls the total amount of funds that are used for a particular budget activity during the year. The CNO's comptroller (OP-82) reallocates O&M,N funds to major claimants, who in turn issues allotments or operating budgets to field activities (Practical Comptrollership, 1989, p.D-6). For the purpose of this thesis, the major claimant for all squadron funding is Commander-in-Chief, U.S. Pacific Fleet (CINCPACFLT) and the field activity is Commander, Naval Air Pacific (CNAP).

CNAP allocates funds or Operating Targets (OPTAR) to CPWP, which in turn allocates them directly to the individual VP squadrons. The OPTAR holder has an administrative limitation rather than a legal limitation on spending. This does not mean the Squadron CO can overspend his budgeted figure. To the contrary, he is monitored very closely by both CPWP and CNAP to insure that his OPTAR is not exceeded. Figure 3 on the following page provides a schematic for the squadron funding from beginning to end.

The major claimant for WST funding is Naval Air Systems Command and the field activity is Contractor Operation and

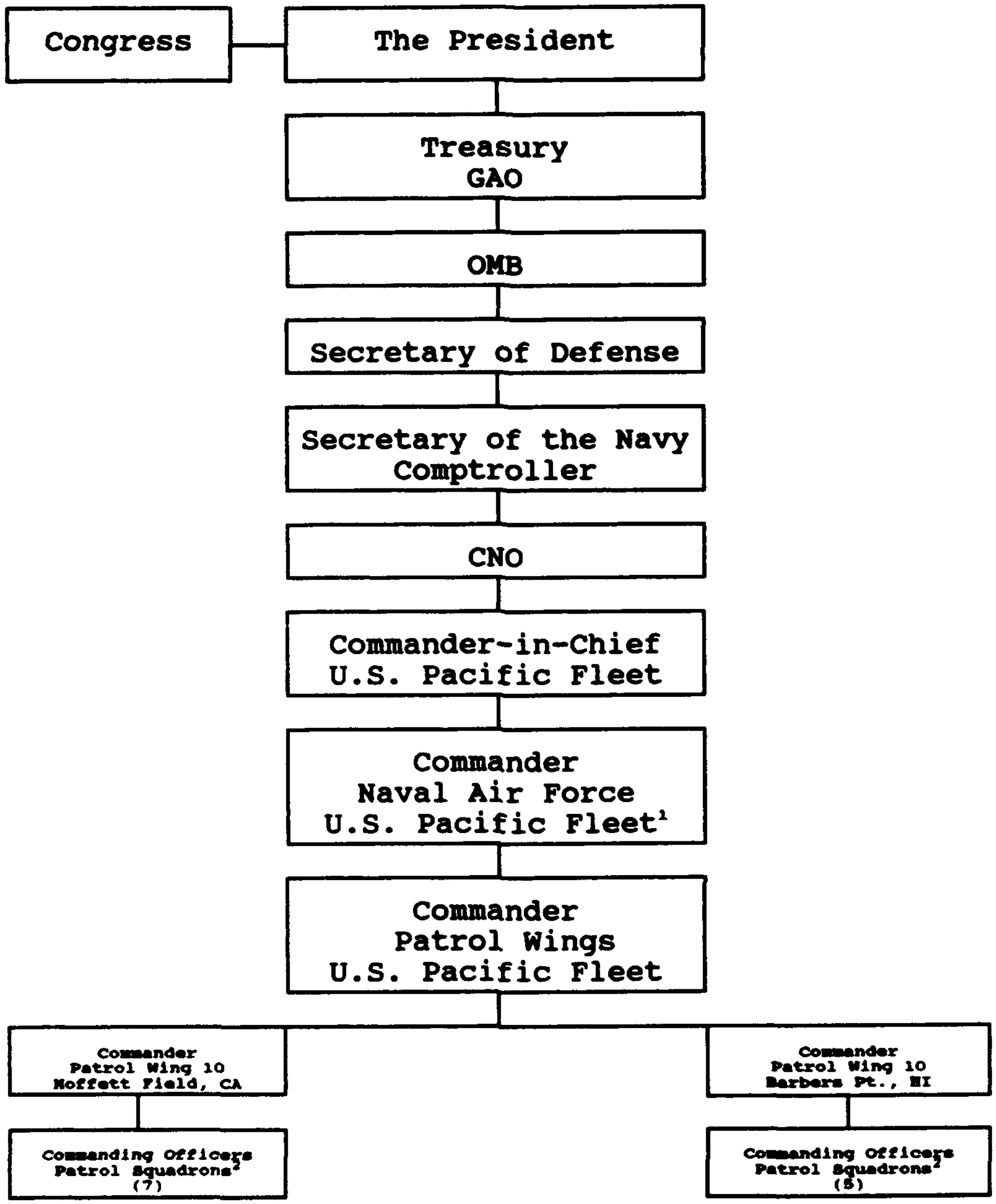
Maintenance of Simulators (COMS). Additional simulator funding is provided by Naval Training Systems Center to CNAP for "premium hours." WST funding is simply a fixed amount each year. A contract is let to operate and maintain each trainer site. This is a fixed price contract and funded by COMS. The contract price is the basis for the $29 per hour per trainer operating and maintenance cost figure.

The common problem of needing additional training periods when all regular periods are already committed is called surge demand. This problem is solved with a lump sum of "premium hour" funds provided by Naval Training System Center to CNAP which, in turn, provides these funds to CPWP. They are used for overtime training hours, especially weekend or extra night periods. The surge demand may have been planned or due to some unforeseen requirement. For whatever reason, funds are available-but only for simulator training.

E. BUDGET EXECUTION

As mentioned earlier, quarterly distribution of flight hour funds often causes a disruption in planning and scheduling.

> The allocation of O&M,N funds by operational commanders is a continuous process because of the practice of quarterly apportionment by OMB and also due to the uncertain outcomes of the budgetary process. This lack of long-term funding precludes meaningful long-range planning. Planners are forced into a continuous "what if" scenario developing numerous budgeting contingencies. (Blake, 1988, p. 17)



[1] Responsibility center and the Operating Budget Holder (OPBUD). Lowest level holding legal spending limits.

[2] Cost Center with administrative vice legal limitations. Issued Operating Targets (OPTAR).

Source: Diagram adapted from (Practical Comptrollership Manual 1989, p. D-7 and Blake, p.13).

Figure 3. Flow of VP Squadron Funds

CPWP's flying hour program allocation must optimize force readiness as well as meet all operational commitments. Working closely with each Wing Commander (although he is not formally involved in budget allocation and execution), CPWP allots an OPTAR to each squadron based on which phase each is in. The highest amount is allotted to deployed squadrons, the second highest to those in Ready Alert, and the least to those in training. Since each quarter's funding level may be different, CPWP, the Wing Commanders, and the squadron's find it difficult to plan longer than one quarter.

After the initial quarterly distribution, flying hours and funds are moved to appropriate squadrons to provide for unforeseen operational contingencies. When this occurs, flying hours may be taken away from scheduled training events, since additional hours (surge protection) are unavailable. This is in contrast to the availability of funds for WST "premium hours." In discussions with senior Commanders, the only explanation as to why a contingency fund does not exist for flight hours is that fight hour funds are directed to be reduced to zero. A contingency reserve implies that funds may not be used if a contingency does not develop and, therefore, is unacceptable due to the belief that the budget will be reduced for the next period by the amount not used in the current period.

In the past, the squadron commanding officer, who is the end user of training resources, was not directly evaluated on the use of these assets. According to Blake (1988) and Bozin (1981) this was a flaw in the management control system. Now, with the focus on cutback management, the authors of this thesis find that Wing Commanders do rate Commanding Officers highly on their ability to manage available funds. However, the Wing Commander, who is the primary evaluator of squadron performance and signs the fitness reports for the squadron commanding officers is not formally involved in the budget process.

This chapter provided an understanding of how the budget for VP squadron funds (flight and trainer hours) is developed and how the allocated funds are distributed down the chain of command. The discussion focused on the role PMR plays in Budget preparation. Future chapters will evaluate the readiness using this discussion as a baseline.

VI. READINESS

The Department of Defense has continued to put a major emphasis on the readiness of the armed forces. In preparing for the fiscal year 1990/91 budget, then Secretary of Defense Frank Carlucci stated that his budget priorities were in "quality people and in readiness." (DOD Authorization and Appropriations Hearings, 1990, p. 691) Vice Admiral Stanley R. Arthur, in congressional hearings for the same budget, echoed Secretary Carlucci's statement. However, he indicated that readiness would not drive all resource expenditures.

> We feel that we cannot continue to let the infra structure deteriorate to protect direct readiness, because these support elements are being degraded to the point that overall readiness is *being affected.* Fleet readiness, modernization, engineering and logistic support must remain in balance as a matter of vital importance given that our navy forces continue to be thrust in harms way (DOD Authorization and Appropriations Hearings, 1990, p. 691).

In the recent past, the Navy shifted funds from maintaining the infrastructure to support readiness. Admiral Arthur indicates this shift can no longer be justified because these infrastructure assets (e.g., hangers, runways, physical plants) are deteriorating to such a degree that siphoning additional funds into direct readiness without the supporting these assets would degrade overall readiness. This means that, if Navy's budget is going to be cut, as expected, Naval readiness will suffer in the same proportion as other funding requirements. Thus, efficiency in spending readiness dollars is paramount.

A. MILITARY READINESS SYSTEM

In order to have an understanding of readiness one must comprehend four concepts, military readiness, combat readiness, readiness areas, and readiness categories. Military readiness, as previously discussed in Chapter I, is having the proper mix of people and equipment to perform effectively at the initiation of hostilities (Laird, 1980, p. 17). Combat readiness simply refers to whether a unit is certified ready for combat.

The overall military readiness rating of a unit depends upon readiness measurements in four areas, personnel, equipment, supplies on hand and training. These four areas are derived from three of the military readiness definition's key words: "people," "equipment," and "perform." "People" refers to personnel readiness, "equipment" refers to both equipment readiness and supplies-on-hand readiness and "perform" refers to performance or, more precisely, training readiness. Military Commanding Officers must continually measure how ready their units are in terms of these four readiness areas to derive their units' overall mission readiness.

Personnel readiness is a measure of whether or not a unit has enough people to accomplish a mission. Equipment readiness involves measuring the military equipment's ability to perform as designed. Supplies-on-hand readiness measures whether or not a unit has enough equipment physically on hand. Training readiness in essence is a measurement of the personnel-equipment interface in getting the mission accomplished. As Melvin Laird states, "(Training readiness) is the most complex area of readiness to quantify." (Laird 1980, p. 19) This thesis concentrates on the training readiness portion of the readiness system.

B. STATUS OF RESOURCES AND TRAINING SYSTEM

In 1980, DOD established the Unit Status and Identity Reports (UNITREP) System. This system enabled all units within DOD to report their readiness status in a standardized format to higher authority. It remained relatively unchanged until 1987, when the name was modified to Status of Resources and Training System (SORTS). The reason for this change was primarily to draw Congressional attention to the fact that the readiness reporting system is a measurement of three resource areas and one training area. Previously it had been thought that the UNITREP provided only training readiness figures and did not provide readiness measurements in the three other areas.

SORTS places all units within DOD into one of five readiness categories (C-ratings). These categories are:

- C-1: Fully combat ready. Unit is fully capable of performing the missions for which it was designed or organized.

- C-2: Substantially combat ready. Unit is capable of performing the mission for which it is organized or designed, but has minor deficiencies which could reduce its effectiveness or its ability to conduct sustained operations.

- C-3: Marginally combat ready. Unit has major deficiencies of such magnitude as to severely limit its capability to perform the mission for which it is organized or designed, but is capable of conducting limited operations for a limited period.

- C-4: Not combat ready. Unit has so many deficiencies that it cannot perform its wartime functions.

- C-5: Not Combat ready. Unit is undergoing a planned period of overhaul or maintenance (Laird, 1980, p.17.)

SORTS reports unit readiness in terms of the four readiness areas, personnel, equipment, supplies-on-hand, and training and categorizes them with a C-rating for reporting to higher authority.

With regard to the personnel area, a CO rates the personnel strength of his unit in terms of wartime requirements. In determining the overall personnel rating, he must evaluate three manning areas, overall strength or manning, manning of critical skills for the unit, and senior personnel strength (manning in the senior petty officer ranks E5-E9). The category in which the unit is placed is dependent upon how it matches up against the wartime standard. The unit assumes the C-rating for personnel of the lowest rating of the three manning areas.

CATEGORY	C-1	C-2	C-3	C-4
A. Strength	90-100%	80-90%	70-80%	<70%
B. Critical skills	85-100%	75-85%	65-75%	<65%
C. Senior strength	85-100%	75-85%	65-75%	<65%

With regard to equipment and supplies-on-hand, the CO measures the physical number of major assets on hand and compares this against the established wartime requirement. The percentage of wartime requirement then determines into which category his unit falls. This area is not concerned with the war fighting ability of these assets. While there are several other subareas within the supplies-on-hand area which pertain to different types of naval units, the aircraft subarea is the only area of interest to aviation squadrons.

CATEGORY	C-1	C-2	C-3	C-4
Aircraft	90-100%	80-90%	60-80%	<60%

With regard to equipment readiness, the CO evaluates his major assets together with their on-board systems in term of their ability to perform their assigned wartime mission. Here actual operability of the equipment is measured and made part of the overall readiness figure. The CO determines the percentage of his wartime requirement which is not only on hand but also fully capable of performing its mission. The percentage required in this area to qualify for any category is not as stringent as that for the supplies-on-hand area.

Mission-essential equipment, such as weapons loaders and fuel trucks, are also measured and compared to wartime requirements.

CATEGORY	C-1	C-2	C-3	C-4
A. Major equipment - Aircraft	75-100%	60-75%	50-60%	<50%
B. Mission-essential equipment	90-100%	70-90%	60-70%	<60%

With regard to training, the CO looks at the number of combat ready aircrews and compares this against a standard for each readiness category for wartime. He determines the number of combat ready aircrews through his own community's readiness measurement system. For the VP community this system is the VP readiness and training system.

To determine if a crew is reportable as combat ready within SORTS, VP COs look at each crew's ability to perform in its primary mission areas. This determination is based on the crew being certified, which will be explained later, and obtaining specific additional qualifications pertaining to the primary mission area. The C-rating in training readiness for the squadron is determined from a percentage of the crews with qualification in the different primary mission areas.

CATEGORY	C-1	C-2	C-3	C-4
Combat-ready crews	85-100%	70-85%	55-70%	<55%

Once a CO has determined the C-ratings for his squadron in the above four readiness areas, the overall readiness for the squadron is the least of the readiness ratings in any of the areas. For instance, if a squadron is C-1 for training, personnel, and equipment and supplies on hand, but C-4 for equipment, it is considered C-4 overall. Developing ratings for the first three readiness areas is very straightforward. A VP squadron CO compares the war time requirement with the personnel and aircraft on hand. The resulting percent determines the C-Rating category for each area.

The training readiness area requires the development of a separate measurement system to determine the number of combat ready aircrews. Measuring training is not an exact science. The VP community, as in other communities, requires a standardized system to measure effectiveness so that comparability among units can be established and maintained. The VP Readiness system is the method designed to provide the training readiness measurement for VP squadrons.

C. VP READINESS AND TRAINING SYSTEM

For security reasons the VP readiness and training system can be discussed only in broad terms. However, this should not hinder the understanding of this system itself. For more in-depth understanding the reader is referred to the CPWP Training and Readiness Manual.

There are four major parts to the VP Readiness system (1) certification, (2) advanced qualifications (quals), (3) on top points (OTP), and (4) crew stability. The basis for recognition as a crew starts with certification. Certification means that each crew member has completed or is current in all of its basic requirements. These requirements are:

- NATOPS: Aircrews are required to pass tests to ensure safe operation of the P-3 aircraft. These tests consists of an open and closed book test and an in-flight check.
- Flight Physicals: Aircrews are required to obtain annual flight physicals.
- Aviation Physiology: Crew members must periodically be recertified in water survival and low pressure chamber training.
- Basic qualifications: This requirement refers to a battery of testing by position for minimum skills required to perform in that aircraft position. These qualifications can be completed in the aircraft or WST. A crew member that has been previously certified in that qualification can certify an unqualified member.
- Crew list: A crew is not officially certified until a crew list is published with individuals assigned to each crew position. This list must be signed by the Commanding Officer. It is the document used to enforce stability requirements which will be explained later.

Once certified, a crew begins to obtain advanced qualifications. These qualifications, the majority of which are ASW related, involve testing of various crew members working as a team to perform a task. The specific crew members involved for each qualification is dependent upon the advanced qualification desired. These advanced qualifications are designed to certify acceptable performance in the primary mission areas discussed in Chapter V. They are usually submitted by the wing commander's staff and certified by the squadron CO.

The third major portion of the readiness system revolves around the concept of an OTP. An OTP is a certification that a crew was "on top" a submarine in position to drop a weapon, if required. Just being able to get "on top" a submarine is the culmination of all the training efforts completed to that point and in itself is thought to signify combat readiness. The number of OTPs obtained over a period of time is believed to be a very good indicator of crew performance. For this reason, a crew is required to obtain a specific number of OTPs over a 3-month period. OTPs can be obtained in conjunction with advanced qualifications when possible. Time parameters, however, are usually stricter for qualifications than for OTPs. While most advanced qualifications are obtained in the WST, the majority of OTPs are required to be obtained in the aircraft on actual submarines.

The final part of the VP readiness system involves crew stability. A crew is considered to have stability when four critical crew members are together as a crew for a specified uninterrupted period of time. The four critical crew members for VP as defined by the VP Readiness Training Manual are the PPC, TACCO, SS1, and SS3. The readiness system has specific requirements for critical crew members to train together on

OTPs and advanced qualifications. The system further penalizes crews which fail to maintain crew stability.

The VP readiness system combines measurements within the four areas previously discussed to determine the overall readiness of each crew. Within this system the crew can fall into one of four categories, called crew designation levels (CDLs), Alpha (A), Bravo (B), Charlie (C), or Delta (D). Alpha is considered the most ready and Delta is consider not ready.

The individual ratings of each crew are combined into a figure called Average Crew Readiness (ACR). ACR is developed by assigning a number to each crew in a squadron, based on its rating, thus: 1.0 for A, 0.8 for B, 0.6 for C, and .2 for D. These numbers are then added together for all the crews in the squadron to obtain the final squadron ACR. ACR is used widely within the VP community to compare squadron performance and, thus, is of much interest to this thesis.

D. PRIMARY MISSION READINESS AND THE READINESS SYSTEM

As explained in Chapter V, PMR uses flight hours to quantify performance levels in each primary mission area. PMR is derived from the estimates of the hours required to achieve qualifications in these areas. While it does take into account the need to obtain these qualifications to become proficient in the primary mission areas, the system basically professes that flight hours alone translate into readiness.

These PMR flight hour estimates have come under scrutiny but, as mentioned earlier, survive today as the major input for VP funding.

The VP Readiness system uses the four previously specified areas (certification, advanced quals, OTPs, and crew stability) to quantify squadron readiness; flight hours are not used in this readiness calculation. Herein lies a management control problem: the majority of VP funding is determined by PMR or flight hours but flight hours are not used as a performance indicator in the VP readiness system. So the system uses flight hours to justify funding and COs must use flight hours to achieve readiness, but no link between the two has been established.

VII. METHODOLOGY, DATA PRESENTATION AND ANALYSIS

The previous chapters discussed funding for the VP squadrons and the important role primary mission readiness (PMR) plays in this process. They further described the VP readiness system and how the concept of average crew readiness (ACR) is used as a basis for measuring squadron readiness. The purpose of this thesis is to establish a link between PMR and true readiness. The methodology used to achieve this purpose is described below.

A. METHODOLOGY OVERVIEW

Figure 4 displays the authors' model to illustrate the steps that occur during the process of transforming dollars into actual readiness; it ties together the VP budgeting process and the VP readiness system. The CPWP flight hour

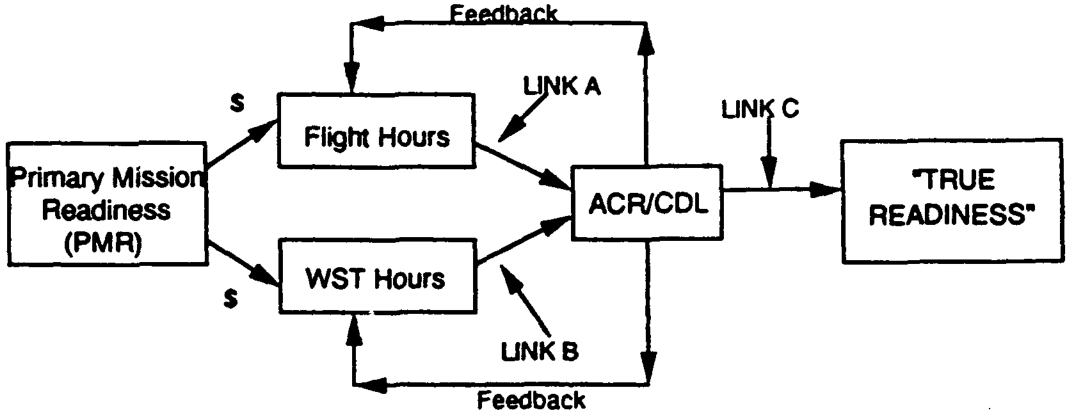


Figure 4. Model Relating Funding to True Readiness

study establishes PMR for VP aircrews. Together, Weapon System Trainer (WST) and flight hours satisfy this PMR requirement. The flight hour PMR requirement (85% of the total) is translated into dollars by multiplying the required hours by the historical flight hour cost. WST hours, as explained in Chapter V, are acquired by a fixed price contract. Each squadron CO simply receives his fair share of the contracted hours.

A CO uses flight hours and WST hours to train and to improve readiness as measured by the VP readiness system. As previously described, ACR is the CO's yardstick for measuring this readiness. The VP readiness system is the management control system he uses in deciding how to expend flight hours and WST hours for readiness. COs typically expend more flight hours on crews with lower readiness statistics (lower crew designation levels (CDLs)) in order to increase their paper readiness. This may be done without regard to their actual need for training. The strength of the feedback loop is a function of the CO's motivation to expend resources to maximize paper readiness.

This thesis attempts to validate the links between flight hours and ACR (link A in Figure 4), WST hours and ACR (link B in Figure 4), and ACR and "true readiness" (link C in Figure 4). The process by which this validation takes place is segmented into four phases. Each phase built upon the results from the preceding phase.

Phase one tries to substantiate links A, B, and C by using aggregate CPWP annual and monthly data. It validated link A on an aggregate annual basis but it was unsuccessful in establishing links B and C. Phase two was then initiated to support the three links using squadron monthly data. No links were established in this phase. Phase three was an attempt to establish the links from an entirely different perspective. It tried to substantiate link C first by identifying effective and less effective crews from actual operational flight data. This method was unsuccessful because not enough less effective crews could be identified from which to draw statistical conclusions. Phase four was the final effort to establish links A, B, and C. In this phase, effective and less effective crews were subjectively identified. The flight and training records of the individual members of these crews were then thoroughly analyzed. While none of the three links could be established, several characteristics were identified that could help a commanding officer maximize his true readiness in the future.

B. DATA PRESENTATION AND ANALYSIS

1. Phase One

Phase one was a broad attempt to validate the relationship between ACR and flight hours (link A) that CPWP uses as a tool to justify resource requirements. CPWP uses a graph of the relationship between ACR and flight hours over the five year period between fiscal year 1985 and fiscal year 1989, inclusive, to validate link A. The CPWP staff uses the apparent correlation in this graph to justify the flight hour program and to document the impact of flight hour cuts to higher authority. The authors attempted to determine the statistical significance of this apparent relationship. In validating the relationship, average yearly ACR for the twelve squadrons in CPWP was regressed against flight hours for those years. Table 1 displays the results of this regression.

Table 1

REGRESSION OF
CPWP 5-YEAR FLIGHT HOUR TOTALS(X) and ACR(Y)

Regression Equation: $Y=.40547+.000005449\ X$ Relevance:High

Number of Data Points	R^2:	p-Value:	t-Value:	F-Test:
5	.818	.0349	3.673	13.491

In determining the statistical significance of the regressions and t-tests computed in this chapter, the authors used two major parameters, R^2 and p-value. R^2 gives the reader insight as to how spread out the data are about the calculated regression equation. It is the percentage of the total variation in a dependent variable (ACR in Table 1) that is explained by variation in the independent variable (flight hours in Table 1). Thus, the higher the R^2 value the better. A value of 50% indicates that a significant regression equation can be used to explain 50% of the variation in the Y variable with confidence for prediction. The p-value shows the statistical significance of the X variable in explaining the variation in the Y variable. For the purposes of this thesis, p-values less than .05 are considered significant. A p-value of .05 means that there is a 95% chance that the Y variable does indeed vary in a meaningful way with the X variable. Thus, there is only a 5 percent chance that the apparent relationship is purely coincidental. For the purpose of prediction, an R^2 of less than 50% is not reliable even if the relationship between X and Y is significant. Therefore, the overall relevance of a particular regression or T-test is dependent on both the R^2 and p-value. A high relevance, as indicated in the table, is a combination of R^2 of over 50% and a p-value of .05 or less. Other statistical test data are provided as amplifying information for the reader.

The results of Table 1 show a significant relationship between ACR (yearly CPWP Average) and flight hours (yearly CPWP total). As R^2 shows, the regression equation explains 81.8% of the variation. The regression equation indicates that ACR would be 40.5% without any hours flown; flying 1835 hours would increase ACR by 1%. While the equation has some error associated with it, it does validate CPWP's use of flight hours to maintain ACR. Essentially, if a flight hour cut takes place at the beginning of a fiscal year, CPWP can predict what the overall reduction in ACR will be at the end of that year. No data were available at this level to substantiate CPWP's assumption that WST hours played a minimal role in ACR changes.

Having established a strong link at the Wing level, the next step involved breaking down the yearly numbers into monthly ACR/flight hour figures. A relationship here would enable CPWP to determine the effect of flight hour cuts on ACR at any time during the fiscal year. Table 2 shows a simple regression of 24 months of CPWP average ACR and flight hour data.

Table 2

REGRESSION OF
CPWP MONTHLY FLIGHT HOURS(X) and ACR(Y)

Regression Equation: Y=.698 + .00001768 X Relevance:Low

Number of Data Points	R^2:	p-Value:	t-Value:	F-Test:
24	.128	.0867	1.793	3.216

The data showed that total hours, as a predictor of ACR, were not significant at the 95% confidence level (p=.0867). R-square of .128 indicates that, even if the relationship were significant, it could explain only 12.8% of the variation in ACR. In view of this weak relationship, attempts were made to evaluate the effect of time on the data. This was done by lagging ACR from one to six months to determine whether the flight hours expended today affect ACR later.

Lagging data allows one to determine if flight hours expended in previous months had an effect on future readiness. The tabulated results are shown in Table 3.

A lag of one month showed a significant relationship between ACR and hours expended the previous month. However, this relationship does not explain much of the variation in data and therefore cannot be interpreted as a strong validation of link A. As can be seen from the rest of the data in the table, continuing to lag ACR from two to five months showed no significant relationships at the .05 level.

Table 3

EFFECT OF CPWP MONTHLY FLIGHT HOURS ON ACR OVER TIME

	R^2:	p-Value:	F-Test:
1 month later	0.1710	0.0497	4.338
2 months later	0.1770	0.0515	4.290
3 months later	0.0250	0.4911	0.493
4 months later	0.0060	0.7424	0.111
5 months later	0.0090	0.7016	0.152

Since WST usage is fixed and limited, CPWP has presumed that changes in ACR are dependent upon flight hour funding allocations alone. In effect, CPWP has assumed link B not to be of significance. WST hours data are available and tracked at the CPWP level so link B (WST to ACR) could be evaluated. The authors therefore chose to test CPWP's hypothesis about the significance of this link. Table 4 shows the results of this regression. The regression validates the CPWP assumption that WST usage is not significant in explaining ACR variation.

In attempting to validate link C at the CPWP level, the authors had difficulty developing a method to quantify actual readiness of the entire Wing during a period as compared to ACR for the same period. Efforts to develop a method were deemed impracticable. Too many factors, both

Table 4

REGRESSION OF
CPWP MONTHLY WST HOURS(X) and ACR(Y)

Regression Equation: Y=0.761+.0000717 X Relevance:Low

Number of Data Points	R^2:	p-Value:	t-Value:	F-Test:
24	.09	.1545	1.475	2.174

controllable and uncontrollable, affect performance at this level that a paradigm to capture all these factors could not be developed. Even had the authors been able to develop a model, data are not maintained at the Wing level to support testing. The search then continued at the squadron level to establish the links.

2. Phase Two

Phase two began by analyzing data submitted monthly to CPWP by all the squadrons within that command. These data, broken down by squadron and month, include squadron number, ACR, the number of on-top points (OTPs) obtained in a particular month, on station effectiveness (OSE) grades earned during the month, and flight and WST hours expended during a month. The thesis attempted to validate links A and B by using these monthly squadron data. Table 5 presents the results of a regression of monthly ACR to monthly flight hour data over the past two fiscal years for the twelve squadrons within CPWP. No significant relationship was established (p=.1085). The number of data points is 282 vice 288 because some of the squadrons did not have to report ACR for several months due to transitioning to updated aircraft.

Table 5

REGRESSION OF
SQUADRON MONTHLY FLIGHT HOURS(X) and ACR(Y)

Regression Equation: Y=0.765 + .0000714 X Relevance:Low

Number of Data Points	R^2:	p-Value:	t-Value:	F-Test:
282	.009	.1085	1.161	2.592

Table 6 shows the regression of monthly WST hours to monthly ACR at the squadron level. Again no significant relationship was observed (p=.1201).

Table 6

REGRESSION OF
SQUADRON MONTHLY WST HOURS(X) and ACR(Y)

Regression Equation: Y=0.785 + .00003283 X   Relevance:Low

Number of Data Points	R^2:	p-Value:	t-Value:	F-Test:
282	.009	.1201	1.559	2.431

Finally a regression of total hours (WST and Flight hours combined) to ACR was attempted to evaluate a possible aggregate relationship. Table 7 shows the results of this regression. With an R^2 of only .016, the regression equation can not reliably predict ACR from WST and flight hours, even though the very small relationship observed is significant.

Table 7

REGRESSION OF
SQUADRON MONTHLY WST & FLIGHT HOURS(X) and ACR(Y)

Regression Equation: Y=0.744 + .0001038 X   Relevance:Low

Number of Data Points	R^2:	p-Value:	t-Value:	F-Test:
282	.016	.0334	2.138	0.457

An attempt was then made to lag these data but, again, no substantial relationships were obtained. The results are tabulated in Table 8 on the following page. Therefore, there was no separate link A or B and no combined link established by using the CPWP data at the squadron level. The same reasons a link C could not be tested at the CPWP level held true in establishing one at the squadron level. For this reason, a phase three was attempted to overcome the previous problems in coming to grips with validating link C.

3. Phase Three

The purpose of phase three was to validate links A, B, and C from a different perspective. In order to accomplish this, the authors decided to look first at link C (ACR to true readiness) for a relationship. If this relationship is established, then attempts to validate links A and B would proceed.

Table 8

EFFECT OF
SQUADRON MONTHLY WST & FLIGHT HOURS ON ACR OVER TIME

	R^2:	p-Value:	F-Test:
Flight Hours:			
1 month later	0.0060	0.1921	1.7100
2 months later	0.0240	0.0129	6.2660
3 months later	0.0260	0.0120	6.4000
4 months later	0.0340	0.0043	8.3140
WST Hours:			
1 month later	0.0400	0.0090	11.296
2 months later	0.0670	0.0010	18.476
3 months later	0.0660	0.0001	17.179
4 months later	0.0610	0.0001	15.157
WST & Flt Hours:			
1 month later	0.0020	0.5106	0.4340
2 months later	0.1200	0.0736	3.2267
3 months later	0.0140	0.0619	3.5180
4 months later	0.0230	0.0204	5.4480

The authors reviewed over 500 operational flights which occurred during fiscal year 1989 by using the CPWP RAINFORM data base. Operational flights involve flying missions on non-US submarines where the submarine's intent is not known. After each crew debrief, pertinent data about the particular operational flight are added to the database. The reason this database was chosen was because it is the only data maintained which reflect how a crew might perform in a wartime scenario. The authors thought that choosing training data would introduce biases, since more artificialities are present on a training mission. These artificialities include restrictions on the number and types of buoys that can be dropped and prior knowledge of submarine position to regenerate contact.

Initially, all 500 flights were reviewed and put into two categories. If a flight had any contact with a submarine it was placed into one category and all no-contact flights in another. The contact flights were then entered into a database. The database included significant phenomena such as event times, target, crew number, PPC, TACCO, SS1 and mission summary information. Table 9 illustrates the composition of this database. The data in Table 9 have been modified to prevent disclosure of classified information. Classified data, however, were used by the authors in the search for effective and ineffective crews. The authors wanted to enter as much available data as possible so that, once crews were

TABLE 9
SAMPLE DATABASE

Anal	Date	Sqd	Crew	Pilot	Tacco	SS1	CDL	OSE Sts	OSE	TGT	TGT Rate	CTC Onsta	CTC Best	CTC Offst	Trans	Onsta Time	CTC Time	RTB	EQMAL	DBO	Qual	Site	A/C Type	No. Buoys
B	******	1	2	3 Reed	4 Tom	E5 Ed		A	70.0	6	5	BB	DP	NC	142	330	80	100	T		I	XX	C	37
B	******	6	1	4 Smith	4 Sid			W		50	3	DP	DP	NC	185	145	120	185	N	3 Smit	I	YY	C	72
B	******	19	8	3 Gord	3 Pis	E4 Mo		A	78.3	8	7	DP	DP	NC	90	540	253	120	N	3 Jone	C	ZZ	B	27
G	******	6	8	3 Peet	3 Ron	E7 Ben		A	98.7	13	9	DP	CP	DP	210	205	205	215	N		I	YY	C	24
G	******	4	10	4 Will	3 Yatz	E5 Jen		A	100.0	21	6	DP	CP	DP	195	260	228	205	T		I	XX	C	32
G	******	4	10	4 Will	3 Yatz	E5 Jen		A	100.0	37	4	BB	CP	DP	185	321	320	175	N		I	YY	C	63
G	******	4	10	4 Will	3 Yatz	E5 Jen		A	99.8	7	6	BB	CP	DP	190	240	201	185	N		I	ZZ	C	25
Q	******	46	3	3 Lyle	3 Dodd	E5 Ben		W		50	3	NC	BB	NC	210	145	5	170	N	4 Fran	I	YY	C	29
Q	******	17	11	3 Ols	3 Vic	E5 Ral	A	W		13	9	NC	NC	NC	100	410		120	N	3 Bill	C	ZZ	C	50
Q	******	17	8	3 Fred	4 Murr	E5 Ka	A	N		8	7	NC	CP	NC	120	395	146	40	N		I	XX	C1	45

Data Base Key: (All Data in table are for demonstation purposes only.)

Anal: Author assigned grade using Mission Summary statement, type contact, contact off-station. B=Bad, G=Good, Q=Questionable.

Pilot,Tacco,SS1: Rank or rate and name of individual. Number equates to rank, i.e. 3=Lieutenant.

CDL: Crew Designation Level (A,B,C,D). If not listed, CDL unavailable from records.

OSE Sts: On Station Effectiveness score status (A=assigned;W=grade is waived;P=grade is pending, will be released at a later date; N=no grade assigned, usually when no contact is generated.)

OSE: On Station Effectiveness score. Range[0-100]

TGT: CPWP assigned "Target" identification number.

TGT Rate: Author assigned target difficulty rating. 1 indicates most difficult, 10 least difficult.

CTC Onsta: Type "Target" contact held when crew arrived onstation. BB=Bottom Bounce; DP=Direct Path; VI=Visual

CTC Best: Best type "Target" contact held while onstation. CP=CPA Contact; NC=No Contact

CTC Offst: Last type "Target" contact held when crew departed for home base. These codes are specific to the VP community.

Trans: Time in minutes required for crew to transit from home base to onstation point.

Onsta Time: Time in minutes that crew was onstation.

CTC Time: Time in minutes that crew held contact.

RTB: "Return to Base": Time in minutes required for crew to transit from onstation to home base.

EQMAL: Equipment malfunction that may effect crew's performance.
T=Tacco associated equipment; S=SS1 equipment; F=flight station equipment; N=None.

DBO: Debriefing officer's rank or rate and name.

Qual: Report quality; I=incomplete, C=complete.

Site: Location of origin of flight. Codes XX, YY, ZZ indicate specific bases.

A/C Type: Model of P3 aircraft.

Buoys Used: Number of total sonobuoys used on flight.

labeled as effective or less effective, a greater spectrum of data could be analyzed to account for performance disparities.

The flight data were analyzed to evaluate if specific crews distinguished themselves as being particularly effective or not effective in the ASW mission. This was done by reading the mission summary, comparing it with on-station effectiveness (OSE) grades, if assigned, and target tracking information. From this analysis, the event was subjectively given one of three grades: Good, Bad, or Questionable. Questionable flights would be used later to help classify crews that appeared to be marginally good or bad.

Once the event was assigned a grade, the database was sorted by grade, squadron, and crew number. This sort helped in the identification of crew performing consistently "good" or "bad". The authors wanted to find crews with several good or several bad flights to qualify as effective or less effective crews. After looking at the limited operational flight experience of many crews, the authors decided three good or three bad flights would initially distinguish effective from less effective crews. Ten good crews and one bad crew were identified by this method.

Three circumstances, however, prevented continued analysis. First, one bad crew was not enough from which to draw statistical conclusions. Second, of the ten good crews, six were no longer formed because critical crew members had transferred and specific required data were no longer available. Finally, some of the good crews also had questionable and bad flights, which brought into question their true status.

The authors spent over 100 man hours compiling the database. Yet, because of the limited number of operational flights per crew, finding consistently bad performance was not possible to document. This fact, coupled with the nonstandardized way in which the RAINFORM database is entered, prevented further analysis in this phase. The following were specific problems that were encountered with the database.

- Thirty percent of all the flights reviewed had grades of "pending" or "waived" for OSE.
- The Debriefing Officer's (DBO) name was seldom entered, so evaluation of DBO grading history was not possible.
- Contact time developed at debrief and entered into the RAINFORM database did not match the mission commander's analysis of contact time which is also entered into the RAINFORM database.
- The OSE grade and mission summary do not correlate for all flights when an OSE is waived or pending. The mission summary does not specify how the crew actually performed in these cases. If OSEs were pending, no follow-up messages could be found to update the database.
- Crew designation level (CDL), while required to be entered in the RAINFORM database, is seldom entered. This prevents a quick check of the VP readiness system as a performance indicator.

Although phase three did not produce the three links as hoped, the authors obtained a great deal of information for conclusions and further studies to enhance the system. Failure in this phase led to phase four.

4. **Phase Four**

Since the researchers were unable to distinguish effective from less effective crews in phase three by using operational data, phase four was undertaken. A decision was made to request three COs of the available squadrons at Moffett Field to identify their best and worst performing crews during the previous five month period. The authors determined that squadron COs were the only individuals that could subjectively determine effective and less effective crews within their squadrons for several reasons. First, in time of war, the CO would be the one selecting crews for various missions and he is ultimately responsible for ensuring they are all ready for war. Second, the CO constantly changes his ranking based on actual performance. Third, according to Anthony and Herzlinger,

> A judgement made by a qualified person is usually a better measure of the quality of performance than any objective measure...humans incorporate in their judgement the effect of circumstances and nuances of performance that no set of objective measures can take into account. (Anthony and Herzlinger, 1980, p.237)

Finally, five crews selected by the COs matched four effective crews and one less effective crew identified in phase three, thereby offering some confirmation of this methodology. It is the opinion of the authors that, for these reasons, the potential bias that might have been introduced by using this subjective approach is therefore greatly mitigated.

Once it was decided that COs would subjectively determine the crews that attained "true readiness" and those that had fallen somewhat short, the authors selected three squadrons to begin their investigation. The three squadrons that were chosen were determined to be about equal in perceived performance by the Wing 10 staff. These squadron COs were surveyed and asked to identify their two most effective and two least effective crews. A requirement was forced upon them that the PPC, TACCO and SS1 had to have been flying as a crew for at least the past five months (August 1989 to January 1990).

Once the crews had been identified, the process of data collection began. The authors gathered the PPC, TACCO, and SS1 flight log books, readiness records, and training jackets for each of the identified crews. Data were then recorded to obtain the information necessary to distinguish the two groups. Table 10 on the following page displays the data gathering sheets. The authors validated data whenever possible with data maintained at Wing 10.

Since VP performs many missions and this thesis concentrates on ASW readiness, the authors chose to concentrate gathering information on only ASW-related flights and flights which had the potential to increase crew coordination. It was very difficult to gather all the needed information from the different squadrons because squadrons perform the administrative portion of their duties quite differently. Some

TABLE 10

DATA GATHERING FORM

VP
CREW ____ Initially Formed ____ CODE

CDI ____

		September	October	November	December	January	
FPC ____	DATE						ON BOARD ____ YEARS SVC ____ INITIAL PPC ____ NATOPS O ____ C ____ F ____ VP31 ____/____/____/____
Flight Time ____	HOURS						ACTUAL SOVIET FLTS ____
	OSF						TIME VP ____
TACCO ____	DATE						ON BOARD ____ YEARS SVS ____ TACCO DESIG ____ NATOPS O ____ C ____ F ____ VP31 ____/____/____/____
Flight Time ____	HOURS						ACTUAL SOVIET FLTS ____
	OSF						TIME VP ____
SS1 ____	DATE						ON BOARD ____ SVS DATE ____ SS1 DESIG ____ ADV JEZ Y/N NATOPS O ____ C ____ F ____
Flight Time ____	HOURS						A-SCHOOL ____/Stand. ____ ORE W ____/O ____ TIME VP ____ AWTIP ____/____/____/____
	OSF						ACTUAL SOVIET FLTS ____
	DATE						
WSI's	HOURS						
	OSF						

items which were not logged consistently from individual to individual and squadron to squadron (such as Fleet Replacement Squadron (FRS) grades, A-school grades for the SS1, and flight school grades for the officers) could not be analyzed further.

Once the data were collected, attempts were made to validate link C (ACR to true readiness). Table 11 shows the result of a T-test to test this relationship. The test used the five month CDL average for each effective crew and compared these to the same figures for less effective crews. As can be seen from Table 11, there was a difference. Less effective crews had an average CDL .133 lower than that of effective crews. However, this difference was not significant at the 95% level.

Table 11

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF 5 MONTH CDL AVERAGE

	Mean:	St. Dev:	St. Err:
6 Effective Crews	.920	.110	.045
6 Less Effective Crews	.787	.161	.066

Overall Results of Test

t-Value:	p-Value:	Relevance:
1.671	0.1256	Low

A further test was made to see if flight hours could be used to predict readiness for the six effective and six less effective crews. This was done by regressing the crews monthly flight hours over the five month period and comparing this to the monthly CDLs for each of the twelve crews in question. Table 12 provides the results of this regression.

Table 12

REGRESSION OF
MONTHLY CREW FLIGHT HOURS(X) and MONTHLY CREW CDL(Y)

Regression Equation: Y=0.835 + .0.001 X   Relevance:Low

Number of Data Points	R^2:	p-Value:	t-Value:	F-Test:
60	.007	.5173	0.651	0.424

As can be seen from the table, this relationship is not significant (p=.5173 and R^2=.007). Attempts to lag the data did not improve this relationship, as can be seen in Table 13. The data could not be lagged for more than two months because of unavailability of additional data.

Table 13

EFFECT OF CREW FLIGHT HOURS ON CDL OVER TIME

Crew Flt Hours:	R^2:	p-Value:	F-Test:
1 month later	0.0050	0.6386	0.2240
2 months later	0.0880	0.0795	3.2670

The last attempt to validate link A at this level used each crew's five month average CDL and the total flight hours flown by each crew over these five months. Table 14 shows the regression of these data. While there appears to be a relationship here, the R^2 of .391 does not explain much of the variation in the data. Link A validation at this level can therefore be described only as moderate.

Table 14

REGRESSION OF
CREW 5 MONTH TOTAL FLIGHT HOURS(X) and CDL AVERAGE(Y)

Regression Equation: Y=0.671 + 0.001 X Relevance:Low

Number of Data Points	R^2:	p-Value:	t-Value:	F-Test:
12	.391	.0298	2.532	6.411

Link B (WST hours to ACR/CDL) could not be established because these crews spent only limited time in the trainer. This is not unique to these crews and, at least at this level, link B is not significant (as CPWP assumed at its level). Crews not utilizing the trainer at all for five months can still *maintain their readiness* as measured by the VP readiness system. This may indicate a flaw in the readiness system.

The final portion of the research was to evaluate various characteristics of the key crew members to see if they could be used to distinguish effective from less effective crews. This was done so that COs might be able to use criteria other than those measured in the current readiness system to more efficiently train their crews. The authors compared NATOPS open book test results, closed book test results, and flight grades of the PPC, TACCO, and SS1, their years in the service, the time it took each crew member to become fully designated in position, the average days layoff between flights and WSTs, the average OSEs each crew received, the number of months the various crew members had been flying together, and total flight time by position. Table 15 presents a synopsis of the findings listed in order of significance. As can be seen from the table, there were three characteristics significant at the 95% level: the number of months the TACCO and SS1 were on the crew together, the designation time for the TACCO and the average days between flights and WSTs. Refer to Appendix B for complete results from each test. The conclusions and recommendations from this and other tests in this chapter are discussed in the final chapter.

Table 15

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
CREW OVERALL AND INDIVIDUAL CHARACTERISTICS

CHARACTERISTICS	p-VALUE	RELEVANCE
Months For TACCO to Complete Designation	0.0020	High
Months TACCO and SS1 on Crew Together	0.0172	High
Average Days Between Flights or WSTs	0.0378	High
TACCO NATOPS Open Book Test Score	0.0782	Marginal
Crew Average OSE Score	0.1005	Marginal
SS1 NATOPS Flight Test Score	0.1177	Marginal

CHARACTERISTICS	p-VALUE	RELEVANCE
Months Pilot and SS1 on Crew Together	0.1957	Low
Months Pilot and TACCO on Crew Together	0.1957	Low
SS1 Career Flight Hours	0.2949	Low
TACCO NATOPS Flight Test Score	0.3091	Low
SS1 NATOPS Open Book Test Score	0.3235	Low
TACCO NATOPS Closed Book Test Score	0.4364	Low
Pilot NATOPS Flight Test Score	0.4516	Low
Pilot NATOPS Open Book Test Score	0.5167	Very Low
Pilot NATOPS Closed Book Test Score	0.6171	Very Low
Pilot Career Flight Hours	0.6423	Very Low
Pilot Months in Service	0.6491	Very Low
Months For SS1 to Complete Designation	0.6664	Very Low
TACCO Career Flight Hours	0.7065	Very Low
Months For Pilot to Complete Designation	0.9463	Very Low
SS1 Months in Service	0.9586	Very Low
TACCO Months in Service	0.9643	Very Low
SS1 NATOPS Closed Book Test Score	1.0000	Very Low

VIII. CONCLUSIONS AND RECOMMENDATIONS

This chapter provides a concise interpretation of the findings from the previously described research. Six recommendations are made to present the most significant adjustments which can be made to improve the current VP readiness system. Finally, since this thesis was a first look at evaluating the current readiness system in its entirety, the authors provide focused direction for further research.

A. CONCLUSIONS

The conclusions are broken into three subsections dealing with Link A and B, Link C, and training characteristics.

1. Link A and B Conclusions

The following are conclusions regarding the research into developing links A and B:

- There is a valid link A between annual flight hours and ACR at the CPWP level. The graph of flight hours to ACR that CPWP staff uses to justify flight hour requests is significant.
- Once the above analysis is disaggregated to monthly figures, however, the relationship is no longer valid.
- No link A relationship could be established by using squadron or crew ACR/CDL and flight hour figures.
- Link B (WST hours to ACR) could not be established at any level.

The authors believe disaggregating the yearly CPWP figures did not establish a significant relationship because lagging the data could not capture the correlation between flight hours expended in one month and future ACR. The authors do not believe there is a constant effect of flight hours expended in one month to future ACR. This relationship most probably varies from one month to the next and from one squadron to another because of the training environment. The repetition and duration of the flights during the month as well as the way the training is administered all effect the retention of training skills. This all serves to "muddy" the disaggregated relationship between flight hours and ACR. When annual aggregate flight hours are used, the majority of this training retention variable is captured to provide the observed significant relationship.

The authors were not able to establish link B (WST hours and ACR) because WSTs, for the most part, are utilized 100 percent. The WSTs provide virtually the same degree of readiness to the system month after month. WSTs play a minor role in the currently configured VP readiness system.

The existence or nonexistence of link A and B alone does not shed light on resource usage and it's effect on true readiness. Flight hours expended to increase ACR may or may not be increasing true readiness. The readiness system may stress certain accomplishments and qualifications which might not affect true readiness. Unless link C can be established, one cannot know how effective the current VP readiness system is. Establishment of this link is paramount to knowing what factors should be stressed in the computation of ACR/CDL.

2. Link C Conclusions

The conclusions from this subsection have been divided into two parts, for phase three and phase four. Phase three was designed from the outset to develop link C. While the actual link could not be established, several conclusions were developed from the data collection process in this phase.

- VP crews and debriefing officers are not providing all information required to make the RAINFORM database useful. Proper information, when entered, provides an historical perspective on the performance of individual crews. Specific data entry requirements were outlined in the previous chapter.
- Too many on-station-effectiveness(OSEs) grades are waived or left pending with no apparent follow-up. Of the operational events evaluated in Chapter VII, 55 percent of bad flights, 66 percent of questionable flights and 15 percent of good flights were waived or pending.

If the information is entered into the database to provide a basis for improving future performance and to focus future training requirements, all information should be provided to the system. Apparently, DBOs have little problem labeling a good flight as "good". However, they have a problem labeling a bad flight as "bad". Bad flights provide as much or, perhaps, more information for improving crew performance as do good flights. Grading and full disclosure of all flights, and in particular bad flights, are crucial to improving the VP training system.

In phase four, Link C could not be established at the 95 percent significance level by using individual crew data. Since this final step could not establish link C, one can only conclude that the VP readiness system appears to be a poor indicator of true readiness. This gives credence to the belief that the readiness system may measure factors that do not affect true readiness. It may also not measure other factors which have a significant impact on true readiness.

3. Training Characteristics Conclusions

This final section deals with the 23 characteristics which were analyzed in phase four. The findings in phase four, coupled with concepts introduced in Chapter III, provide the basis for this section's *conclusions*.

- The TACCO and SS1 appear to be the critical crew members for VP ASW missions. The current readiness system stresses performance by three crew members on ASW missions: PPC, TACCO, and SS1. It appears the performances of the TACCO and SS1 outweigh that of the PPC on these missions. The current VP readiness system should reflect this.

- Phase four results indicated that limiting the layoff between flights or WSTs rather than "lumping" activity, with longer idle periods between events, improves crew performance. This confirms Chapter III findings. Training should be conducted with distributed methodology in mind. Repetition spread over a period of time improves performance as compared to "lumping" training together.

- Comparing NATOPs grades for crew members is of little value in separating effective from less effective performance.

- Total individual flights as well as time in service cannot be used to distinguish effective and less effective crews.

- The OSE grading system is at best marginally effective in distinguishing effective from less effective crews. This is most likely due to the fact that "bad" or "questionable" flights are often not graded, so OSE averages are inflated and probably not a true indicator of crew performance.

B. RECOMMENDATIONS

Based on the arguments and facts presented in this thesis, the following recommendations are offered to help the VP community in obtaining better performance for its resources:

- CPWP should review the current readiness system with an eye towards incorporating crew flight/WST hours into the ACR calculation. In doing this, CPWP can directly establish link A (flight hours and ACR) and link B (WST hours and ACR) so that PMR and true readiness are correlated at all levels of command. The readiness system, as currently configured, interferes with the incorporation of flight and WST hours.

- CPWP should choose a test squadron on which to perform training research. Once identified, the crews within the squadron should be divided into two groups. One group of crews would be designated the control group and would maintain training practices as prescribed by the current VP readiness system. The other group would train without regard to the current readiness system. This group would train by means of some structured experimental distributed training program. After an extended period of time, the two groups of crews would then undergo standardized testing (such as an operational readiness exercise (ORE)) to compare performance. Based on the results observed from these, tests the VP community would then be in a better position to make readiness system changes.

- If the VP community continues to rely on the RAINFORM database to provide an historical perspective on performance, it should ensure that all data are entered consistently and completely. CPWP should also ensure that the assignment of waived and pending flight grades is limited so that data on average OSEs are not biased. If the VP community is going to have an OSE grading system, it should use the complete system in grading flights.

- CPWP should look at grading flights according to five appropriately weighted facets so that OSEs and, ultimately, performance between crews can be compared. These facets include

  1. Environmental conditions,

  2. Aircraft capability,

  3. Contact class difficulty,

  4. Contact maneuver during prosecution, and

  5. Crew use of tactics, conformity to briefed procedures, and appropriate use of the aircraft, given the tactical situation.

  Currently, a crew is graded only on its performance with regard to the fifth facet. Comparing a crew that obtains a 100 OSE by tracking, with a functioning computer, a loud target which does not maneuver in quiet water is hardly comparable to tracking, without the use of a computer, a maneuvering quiet target within a shipping lane. Improvements should be made to the grading system so that training effectiveness and performance on different flights can be compared more effectively.

- The readiness system should be reviewed and revised in order for it to be tied closer to the SORTs system. SORTs is the system by which the President ultimately receives readiness information on all military units. The system is standardized for all units. A VP readiness system that ties directly into SORTs would ease readiness reporting by squadron COs by allowing the VP community's internal readiness reporting system to be compatible with its external one.

- It is recognized that CPWP has limited manpower resources and expertise to perform the full analysis needed to evaluate the current VP readiness system. Once a methodology has been devised to assess the system, CPWP should use Naval Postgraduate School thesis students to perform the various parts of the needed analysis. The Naval Postgraduate School has many students with a VP background, who can and are willing to perform the required analysis.

C. FUTURE RESEARCH

Additional research into phase four of this thesis could provide significant findings which then could be used as the driving force in further revision of the current VP readiness system. This thesis found three significant factors that could be tracked in a revised readiness system. New studies could be initiated to take a more in-depth look at these factors to find the underlying elements in these factors which can be used to distinguish between good and bad performance. A broader study can also be made to evaluate more characteristics which separate the truly effective performing crews.

Finally, research could be focused on the RAINFORM database. The RAINFORM database was not developed to evaluate operational crew performance. Further study should be conducted into developing a performance database for VP aircrews. Adjustments and additions to the RAINFORM database would undoubtedly need to be made to tailor a system for tracking performance characteristics needed by the VP community.

APPENDIX A

GLOSSARY OF ACRONYMS

ACR	Average Crew Readiness
ASVAB	Armed Services Aptitude Battery Test
ASW	Anti-Submarine Warfare
AW	Anti-Submarine Warfare Rating
CDL	Crew Designation Level
CINCPACFLT	Commander in Chief, U.S. Pacific Fleet
CNAP	Commander, Naval Air Forces, U.S. Pacific Fleet
CNO	Chief of Naval Operations
CO	Commanding Officer
CPWP	Commander, Patrol Wings, U.S. Pacific Fleet
DOD	Department of Defense
ESM	Electronic Support Measures
FASO	Fleet Aviation Specialized Operational Training Group
FE	Flight Engineer
FRS	Fleet Replacement Squadron
FY	Fiscal year
GAO	General Accounting Office
GRH	Gramm-Rudman-Hollings Act
IFT	In-flight Technician
MAD	Magnetic Anomaly Detection
MOE	Measure of Effectiveness

MPA	Maritime Patrol Aviation
NAV/COMM	Navigator/Communicator
NATOPS	Naval Air Training and Operations Procedures Standardization
NFO	Naval Flight Officer
OPTAR	Operating Target
OSE	On-station Effectiveness
OTP	On top point
PMR	Primary Mission Readiness
PPC	Patrol Plane Commander
R/A	Ready Alert
SORTS	Status of Resources and Training System
SS1	Sensor Station One Operator
SS2	Sensor Station Two Operator
SS3	Sensor Station Three Operator
TACCO	Tactical Coordinator
WST	Weapon System Trainer

APPENDIX B

t-TESTS

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
MONTHS FOR TACCO TO COMPLETE DESIGNATION

	Mean:	St. Dev:	St. Err:
6 Effective Crews	15.5	6.221	2.540
6 Less Effective Crews	8.00	1.673	0.683

Overall Results of Test

t-Value:	p-Value:	Relevance:
2.852	.0172	High

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
MONTHS TACCO AND SS1 ON CREW TOGETHER

	Mean:	St. Dev:	St. Err:
6 Effective Crews	19.833	1.941	.792
5 Less Effective Crews	25.800	2.683	1.20

Overall Results of Test

t-Value:	p-Value:	Relevance:
-4.283	0.002	High

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
AVERAGE NUMBER OF DAYS BETWEEN FLIGHTS OR WSTs

	Mean:	St. Dev:	St. Err:
6 Effective Crews	6.003	1.183	0.483
6 Less Effective Crews	9.340	2.683	1.300

Overall Results of Test

t-Value:	p-Value:	Relevance:
-2.392	0.378	High

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
TACCO NATOPS OPEN BOOK TEST SCORES

	Mean:	St. Dev:	St. Err:
6 Effective Crews	3.972	0.0690	0.028
4 Less Effective Crews	3.790	0.2090	0.105

Overall Results of Test

t-Value:	p-Value:	Relevance:
2.019	0.0782	Marginal

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
CREW AVERAGE OSE SCORES

	Mean:	St. Dev:	St. Err:
6 Effective Crews	96.60	4.2420	1.732
6 Less Effective Crews	88.15	10.622	4.336

Overall Results of Test

t-Value:	p-Value:	Relevance:
1.810	0.1005	Marginal

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
SS1 NATOPS FLIGHT TEST SCORES

	Mean:	St. Dev:	St. Err:
6 Effective Crews	3.742	0.138	0.056
6 Less Effective Crews	3.610	0.129	0.053

Overall Results of Test

t-Value:	p-Value:	Relevance:
1.712	0.1177	Marginal

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
MONTHS PILOT AND SS1 ON CREW TOGETHER

	Mean:	St. Dev:	St. Err:
6 Effective Crews	11.333	5.645	2.305
6 Less Effective Crews	8.000	1.673	0.683

Overall Results of Test

t-Value:	p-Value:	Relevance:
1.387	0.197	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
MONTHS PILOT AND TACCO ON CREW TOGETHER

	Mean:	St. Dev:	St. Err:
6 Effective Crews	11.333	5.645	2.305
6 Less Effective Crews	8.000	1.673	0.683

Overall Results of Test

t-Value:	p-Value:	Relevance:
1.387	0.1957	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
SS1 CAREER FLIGHT HOURS

	Mean:	St. Dev:	St. Err:
6 Effective Crews	1344.167	480.487	196.158
6 Less Effective Crews	994.833	607.018	247.814

Overall Results of Test

t-Value:	p-Value:	Relevance:
1.105	0.2949	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
TACCO NATOPS FLIGHT TEST SCORES

	Mean:	St. Dev:	St. Err:
6 Effective Crews	3.758	0.107	0.044
4 Less Effective Crews	3.665	0.168	0.084

Overall Results of Test

t-Value:	p-Value:	Relevance:
1.086	0.3091	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
SS1 NATOPS OPEN BOOK TEST SCORES

	Mean:	St. Dev:	St. Err:
6 Effective Crews	3.752	0.173	0.070
6 Less Effective Crews	3.855	0.172	0.070

Overall Results of Test

t-Value:	p-Value:	Relevance:
-1.038	0.3235	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
TACCO NATOPS CLOSED BOOK TEST SCORES

	Mean:	St. Dev:	St. Err:
6 Effective Crews	3.883	0.194	0.079
4 Less Effective Crews	3.775	0.222	0.111

Overall Results of Test

t-Value:	p-Value:	Relevance:
0.819	0.4364	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
PILOT NATOPS FLIGHT TEST SCORES

	Mean:	St. Dev:	St. Err:
6 Effective Crews	3.867	0.082	0.034
6 Less Effective Crews	3.830	0.080	0.033

Overall Results of Test

t-Value:	p-Value:	Relevance:
0.783	0.4516	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
PILOT NATOPS OPEN BOOK TEST SCORES

	Mean:	St. Dev:	St. Err:
6 Effective Crews	3.888	0.136	0.055
6 Less Effective Crews	3.833	0.148	0.060

Overall Results of Test

t-Value:	p-Value:	Relevance:
-0.516	0.6171	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
PILOT NATOPS CLOSED BOOK TEST SCORES

	Mean:	St. Dev:	St. Err:
6 Effective Crews	3.767	0.163	0.067
6 Less Effective Crews	3.817	0.172	0.070

Overall Results of Test

t-Value:	p-Value:	Relevance:
-0.516	0.6171	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
PILOT CAREER FLIGHT HOURS

	Mean:	St. Dev:	St. Err:
6 Effective Crews	1662.833	830.842	339.190
6 Less Effective Crews	1935.667	1121.171	457.716

Overall Results of Test

t-Value:	p-Value:	Relevance:
-0.479	0.6423	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
PILOT MONTHS IN SERVICE

	Mean:	St. Dev:	St. Err:
6 Effective Crews	77.000	44.806	18.292
6 Less Effective Crews	89.333	46.259	18.885

Overall Results of Test

t-Value:	p-Value:	Relevance:
-0.469	0.6491	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
MONTHS FOR SS1 TO COMPLETE DESIGNATION

	Mean:	St. Dev:	St. Err:
6 Effective Crews	19.667	6.346	2.591
6 Less Effective Crews	18.167	5.307	2.167

Overall Results of Test

t-Value:	p-Value:	Relevance:
0.444	0.6664	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
TACCO CAREER FLIGHT HOURS

	Mean:	St. Dev:	St. Err:
6 Effective Crews	1761.000	776.682	317.079
6 Less Effective Crews	1615.833	488.361	199.372

Overall Results of Test

t-Value:	p-Value:	Relevance:
0.388	0.7065	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
MONTHS FOR PILOT TO COMPLETE DESIGNATION

	Mean:	St. Dev:	St. Err:
6 Effective Crews	22.833	3.312	1.352
6 Less Effective Crews	23.000	4.899	2.000

Overall Results of Test

t-Value:	p-Value:	Relevance:
-0.069	0.9463	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
SS1 MONTHS IN SERVICE

	Mean:	St. Dev:	St. Err:
6 Effective Crews	62.667	39.868	16.276
6 Less Effective Crews	61.167	56.386	23.019

Overall Results of Test

t-Value:	p-Value:	Relevance:
0.053	0.9586	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
TACCO MONTHS IN SERVICE

	Mean:	St. Dev:	St. Err:
6 Effective Crews	71.500	48.891	19.960
6 Less Effective Crews	72.667	38.459	15.701

Overall Results of Test

t-Value:	p-Value:	Relevance:
-0.046	0.9643	Low

UNPAIRED t-TEST OF EFFECTIVE AND LESS EFFECTIVE CREWS
TESTING SIGNIFICANCE OF
SS1 NATOPS CLOSED BOOK TEST SCORES

	Mean:	St. Dev:	St. Err:
6 Effective Crews	3.600	0.261	0.106
6 Less Effective Crews	3.600	0.228	0.093

Overall Results of Test

t-Value:	p-Value:	Relevance:
000000	1.000	Low

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